technique

of

house nailing

OUSING AND HOME FINANCE AGENCY • WASHINGTON, D. C.

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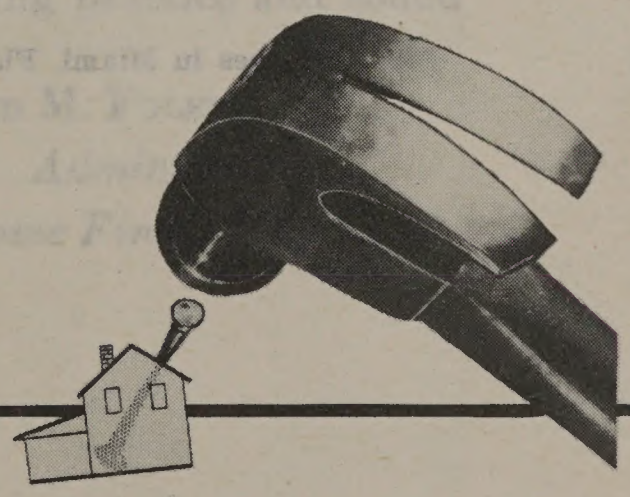
by Forest Products Laboratory, Forest Service

U. S. Department of Agriculture

in collaboration with

the Technical Staff of the

Housing and Home Finance Agency



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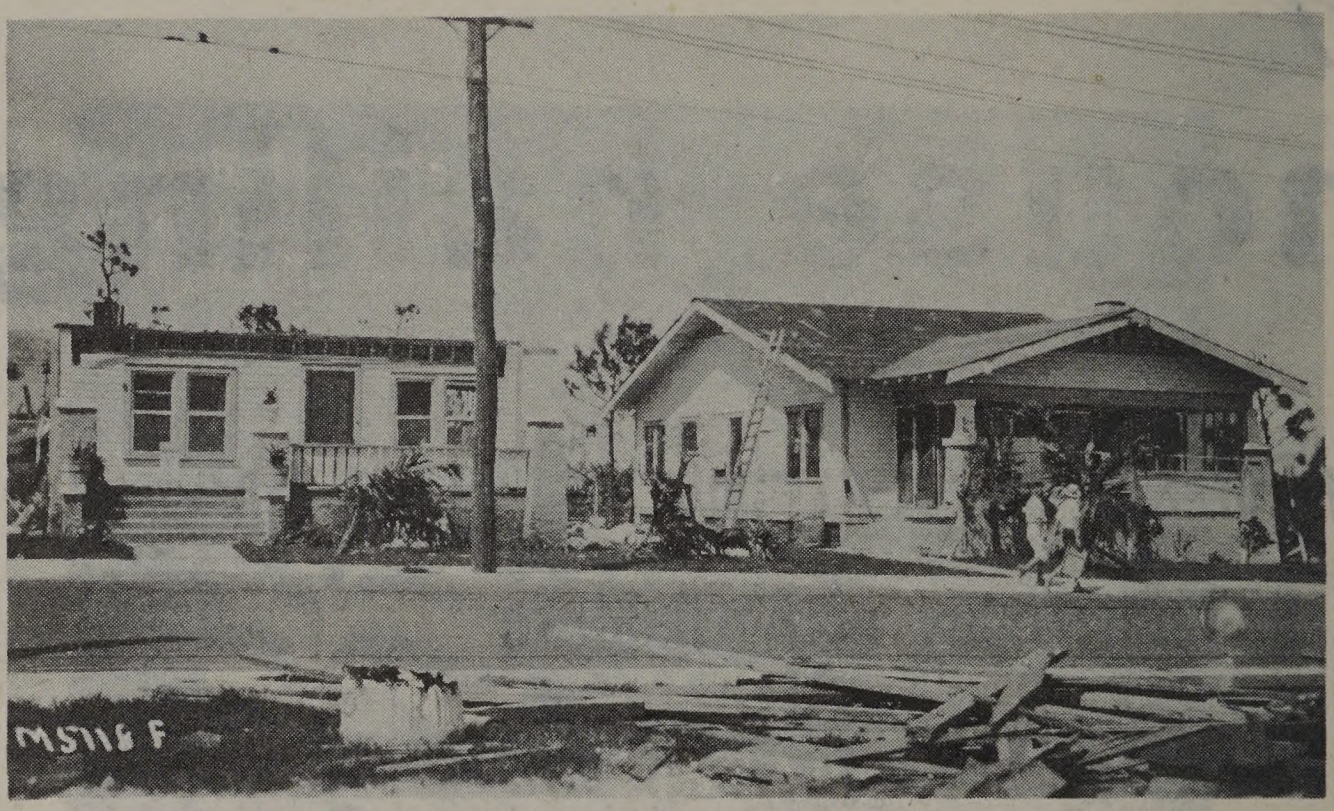

Houses in Miami, Fla., after a hurricane. Left, insufficiently nailed; right, well-nailed.

This bulletin was prepared by the staff of the Forest Products Laboratory in collaboration with the National Housing Agency and arrangements for publication were made by that Agency. It is being issued by the Office of the Administrator, Housing and Home Finance Agency, which succeeded NHA pursuant to Reorganization Plan No. 3, effective July 27, 1947.

FOREWORD

The importance of correct nailing in house construction is generally recognized, but there has existed up to now in the literature on house construction no precise and authoritative booklet giving specifications for nailing. This publication is expected to fill that need.

The nailing techniques illustrated in this booklet are based upon an accumulation of information obtained from a number of sources: engineering studies, testing, observation of nailing practices, and investigations conducted by the Forest Products Laboratory.

Since the greater number of our houses are still built of wood, and since nails are still the principal fasteners for wood construction, it is hoped that this publication will provide information for home builders which will generally promote correct nailing practice and sound construction.

RAYMOND M. FOLEY,
Administrator,
Housing and Home Finance Agency.

ACKNOWLEDGMENT

This publication has been prepared by the Forest Products Laboratory, Forest Service, United States Department of Agriculture, in collaboration with the former Technical Office of the National Housing Agency (*now the Technical Staff of the Housing and Home Finance Agency*). It is based principally upon results of research and test work carried on at the Forest Products Laboratory. Text and illustrations were prepared by Otto C. Heyer and T. R. C. Wilson, Forest Products Laboratory engineers. Much of the test work upon which the manual is based was done by J. M. Gahagan, member of the Forest Products Laboratory staff since retired.

CONTENTS

TECHNIQUE OF HOUSE NAILING

INTRODUCTION

The strength of any wood structure depends to an important extent on how well the parts and elements are fastened together. The principal fastenings in a wood-framed house are nails, and its solidity is largely determined by the effectiveness of the nailing. In erecting wood buildings it is therefore important to know the size, number, and placement of nails required to withstand the forces that the parts of a house must resist.

That nailing is a major factor in developing strong and rigid frame houses is shown by the action of storms (see frontispiece). Many well-nailed and well-constructed wood buildings have survived for decades the severe weather cycles and the occasional storms of hurricane intensity that occur in many parts of the country. On the other hand, under severe storm conditions, houses with inadequate nailing often separate into parts or even into individual pieces of framing, few of which are actually broken. This demonstrates that the weakness was in the nailing rather than in the wood parts themselves. Surveys in storm-damaged areas show that houses standing intact and plumb amid broken trees and the wreckage of neighboring houses are invariably those which, in addition to other features of good construction, are adequately nailed. A report of an engineering study of the 1925 Florida hurricane says, "Hasty carpentry work and a lack of nails caused most of the failures in frame dwellings." [1] Another such report states, "In woodframe buildings it is important to take particular care that the rafters are securely spiked to the side walls and the ends of all partitions are well spiked to the walls." [2]

Although correct nailing is highly important, the literature of house construction has not contained any complete nailing schedule or recommended practice for nailing together the parts of a house. There is much difference of opinion as to what constitutes proper nailing of the elements of a wood house, and, consequently, a large variation in nailing practice, even within limited areas. Current nailing practice—usually a matter of precedent, tradition, or individual

[1] Ruggles, C. H., and Eefting, T. More on General and Structural Effects of Florida Hurricane, Engineering News-Record, 97 : 946–948. 1926.

[2] Schmitt, F. E. The Florida Hurricane and Some of Its Effects, Engineering News-Record, 97 : 586–592, illus. 1926.

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judgment—as a rule does not really take into account the forces to be resisted.

The information presented here on how to nail house framing is a nailing schedule that fulfills a long-felt need. It is impossible, however, at the present time to set up a nailing schedule solely on the basis of engineering design and research data. Rather, the recommendations set forth in this publication by means of drawings are based on data from a number of sources, including the results of tests made at the Forest Products Laboratory, observations of nailing practice in various parts of the United States, and information obtained from architects, engineers, and carpenters.

PURPOSE

The purpose of this publication is to set up a general specification for nailing, which it is hoped will help to replace haphazard nailing practices with sound and efficient ones in house construction. The information should be of value to engineers, architects, carpenters, and prospective home owners in serving as a guide to the building of better houses. It should furnish a standard by which one can judge the quality of the nailing in the construction of his own house. It should also be an aid in the training of carpenter apprentices.

SCOPE

This publication does not favor any particular design of framing, but merely refers to acceptable practice in assembling and arranging parts in any structurally well-designed frame house of the balloon, platform, or other type. It limits nailing instructions largely to structural details necessary for rigidity and strength without considering trim or other decorative parts.

Many of the joints in a house are not subject to analysis with respect to the forces that must be resisted and, consequently, cannot be designed on an engineering basis. The attachment of the lower end of a stud to a sole plate is an example. The nailing specified for such joints is based on judgment and experience, and approximates that practiced by conscientious workmen and contractors.

The force that nails are required to resist in some other types of joints can be computed from loading requirements, such as given in building codes, and the required size and number of nails can be determined from data on nail resistance. The attachment of ledgers to girders and of joists to headers are examples of such joints.

RECOMMENDATIONS FOR NAILING

The recommendations for nailing a house are given in a series of drawings, each representing one construction detail (figs. 1 to 51).

Each drawing with the accompanying description shows the number and size of nails recommended as well as the placing and the direction in which they are to be driven. Except where otherwise indicated, common wire nails are to be used.

The species of wood used will necessitate no difference in nailing except in the more critical joints. In those places, if woods of comparatively low density, such as Engelmann spruce, northern cedar, and cottonwood, are used, an increase in the number or size of nails is necessary to compensate for their lower nail-holding power. The more critical joints in house construction are those illustrated in figures 6, 18, 19 (bracing), 21 (joist and stud), 22, 26 (collar beam), 31 to 34, and 44 to 51. The nailing indicated in the other illustrations applies to any species that is at all likely to be used.

The sizes of nails indicated in the various drawings are the minimum sizes considered suitable for the particular purpose. In some instances, it may be desirable to increase the size in order to have fewer sizes to be supplied to a job or to be carried by the carpenter at one time. Ordinarily, nails one size larger than that shown are acceptable, provided they do not cause splitting.

Except where otherwise stated, the use of nominal 2-inch material for framing members is assumed. If thicker material is used, proper penetration into the second member will require longer nails than those specified.

In most joints in house construction, one piece tends to slide on an adjacent one because of the loads or forces met. Resistance of nails to such forces is termed "lateral resistance." Nails through trimmer joists into the ends of headers, nails through header into the ends of tail beams, nails attaching ledger strips to girders, are subjected to such loads or forces. Lateral resistance of nails attaching wall sheathing or interior wall coverings of sheet materials to the frame comes into action in resisting forces that tend to rack the wall and in carrying the weights of such materials. Lateral resistance of nails also works against the horizontal thrust of rafters attached to ceiling joists or to plates.

The other way in which nails are stressed, or loaded, is in "direct pull" or withdrawal. Nails attaching covering materials to the lower edges of joists or rafters are stressed in direct pull by the weights of those materials. Similar stress is induced by warping, by vibration, and by wind suction. Ordinarily, when sufficient lateral resistance has been provided, ample resistance to direct pull will be available.

Additional resistance to thrust of rafters and to uplift can in some instances be provided very simply by the use of metal strapping in conjunction with nails. Such use is indicated in several of the drawings. The straps should be not less than 0.028 inch thick by 1 inch wide and should be galvanized or otherwise protected against rusting. When metal straps are used in this way, they should not be

punctured by the nails that attach covering materials. Several types of sheet metal connectors are also on the market, some of which, when properly installed and nailed, afford adequate connections between framing members.

No matter how well a house is nailed, it is not adequately protected against storm, earthquake, or flood unless it is firmly attached to the foundation. A commonly specified requirement is that sills be connected to the foundation by bolts not less than one-half inch in diameter, spaced not farther apart than 6 feet. The bolts should extend not less than 10 inches into concrete foundations. In stone, brick, or concrete-block foundations, anchorage is dependent upon the strength of the mortar bond. If used, bolts should extend at least 15 inches and be attached to anchor plates at least 3 inches square that are embedded in a mortar joint between courses. Bolts or rods of larger diameter and greater penetration into the foundation are often specified for added safety.

KEY TO DRAWINGS

In the drawings, toenailing and direct nailing are represented by open circles and solid circles, respectively (Fig. 1). The term "toenailing" applies when a nail must be driven at a slant with the initial surface in order to penetrate a second member, as in nailing a stud to a sole plate or sill. "Direct nailing" or "face nailing" applies when the nail is driven perpendicular to the initial surface or to the junction of the pieces joined, as in nailing a top plate to the end of a stud, in connecting members face to face in forming a built-up girder, or in nailing sheathing and subflooring to studs, rafters, and joists.

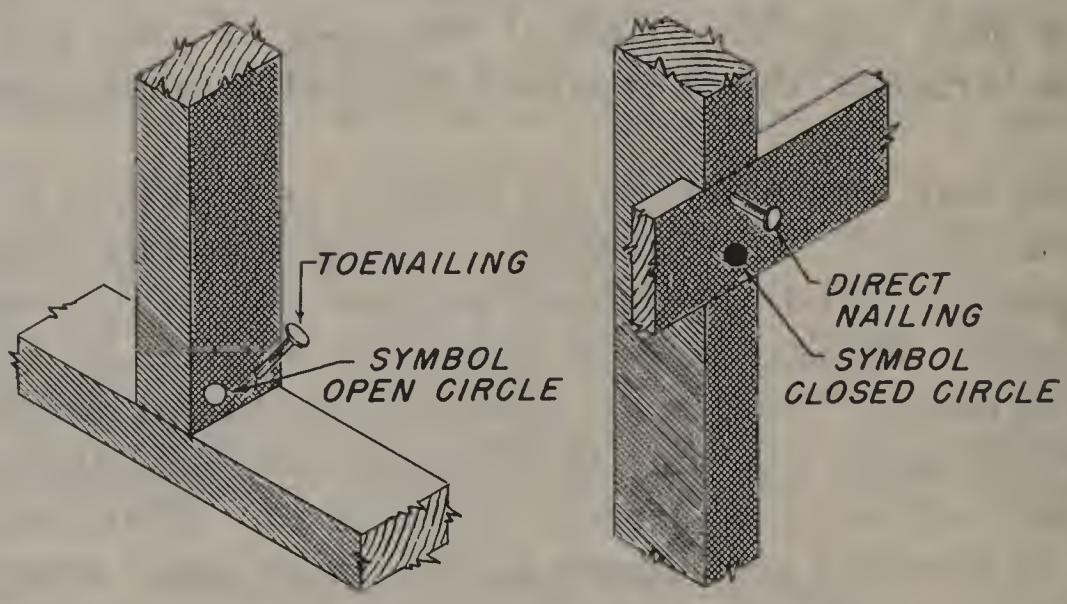


FIGURE 1.—Symbols for nailing. Open circles represent toenailing; closed circles represent direct nailing.

SILL

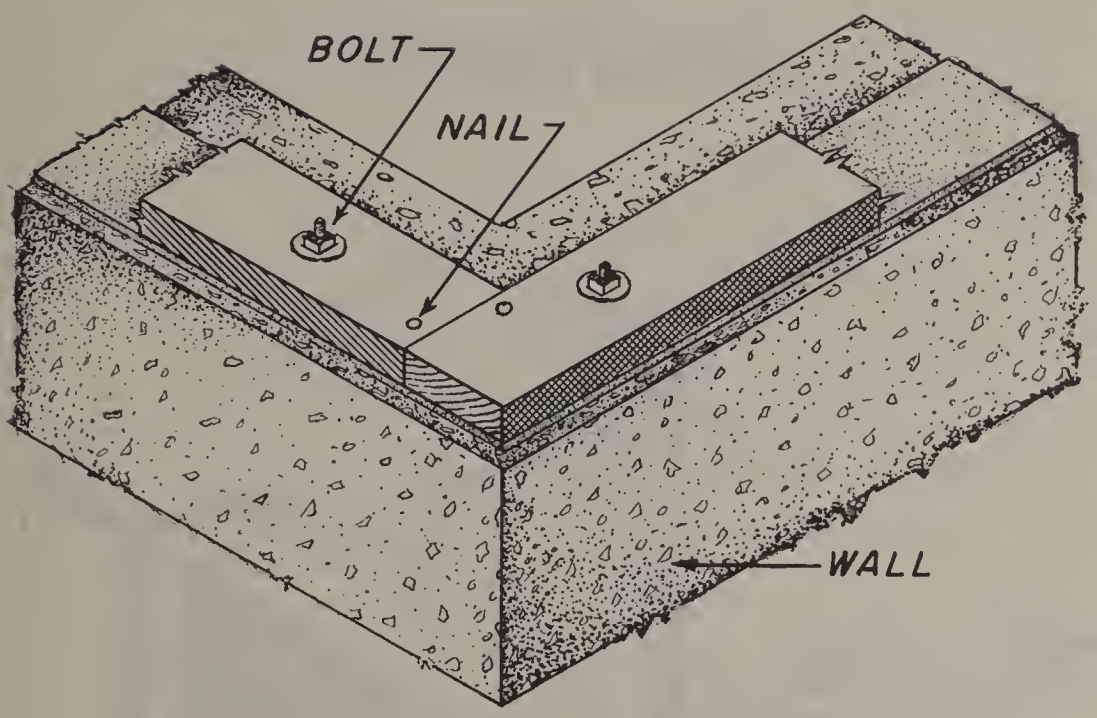


FIGURE 2.—Sill. Adjoining pieces toenailed with two tenpenny nails.

DOUBLE SILL

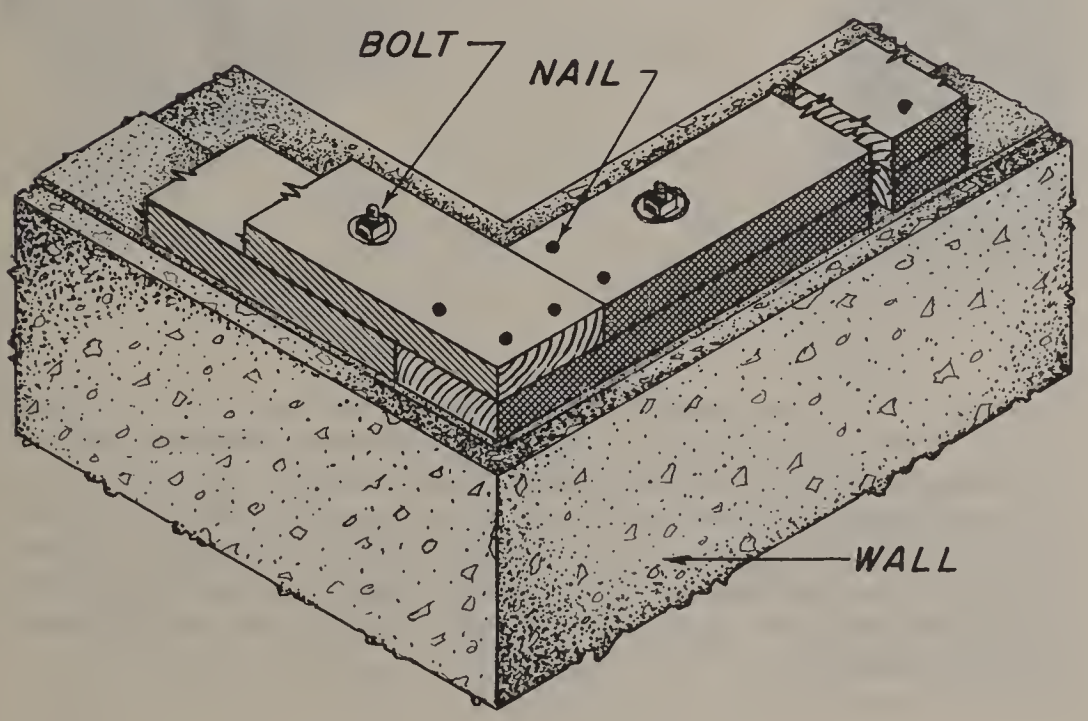


FIGURE 3.—Double sill. Upper part nailed to lower with tenpenny nails; two nails near each end of each piece, others staggered with a longitudinal distance of 24 inches between nails.

TWO-PIECE GIRDER

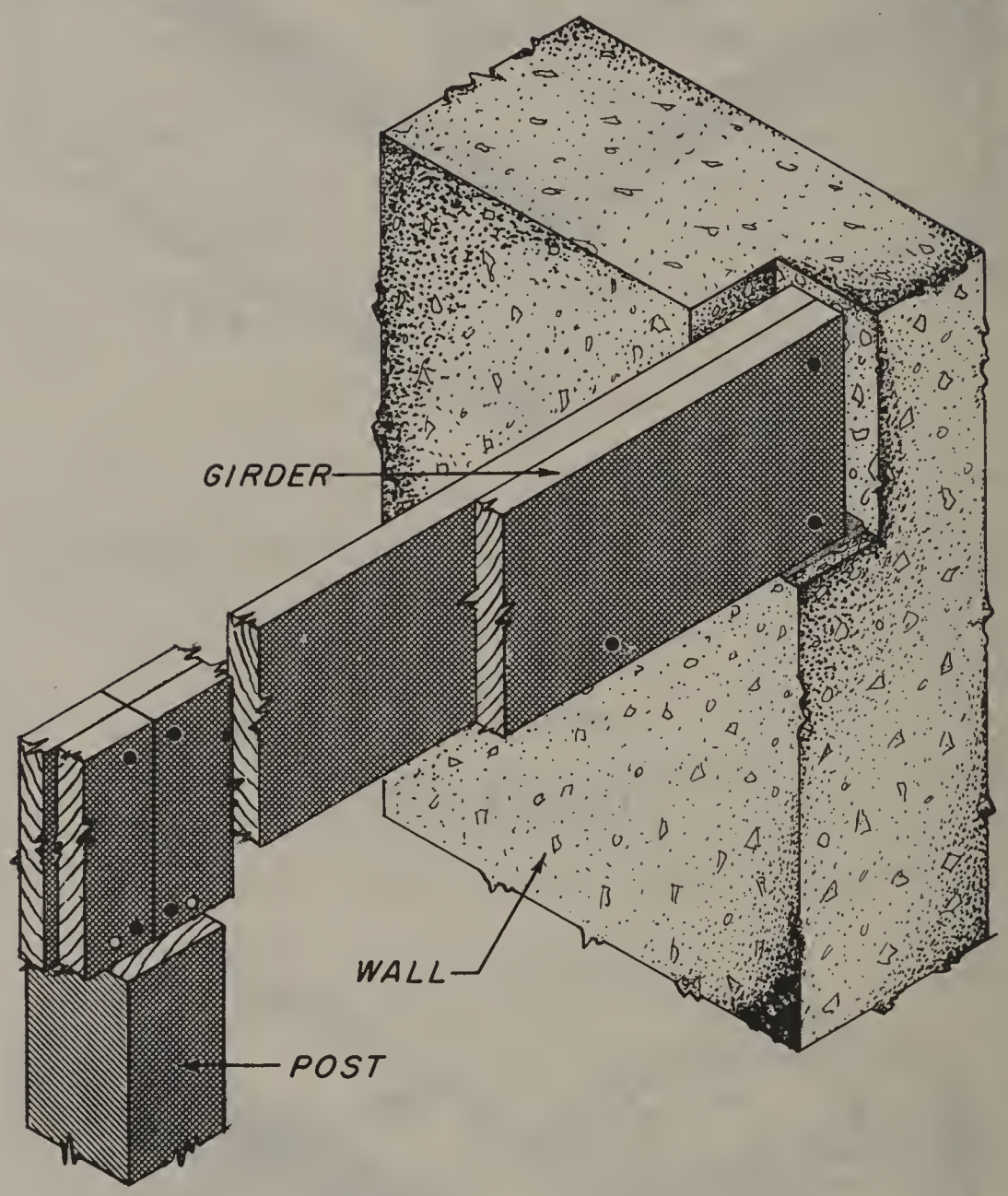


FIGURE 4.—Two-piece girder. Nailed from one side with tenpenny nails, two in each end of each piece, others staggered with a horizontal distance of 16 inches between nails. Alternate construction—nailed from each side with tenpenny nails, two near each end of each piece, others staggered with a horizontal distance of 32 inches between nails. Girder toenailed to post with two tenpenny nails on each side. Note: Girder joints should occur only at supports.

THREE-PIECE GIRDER

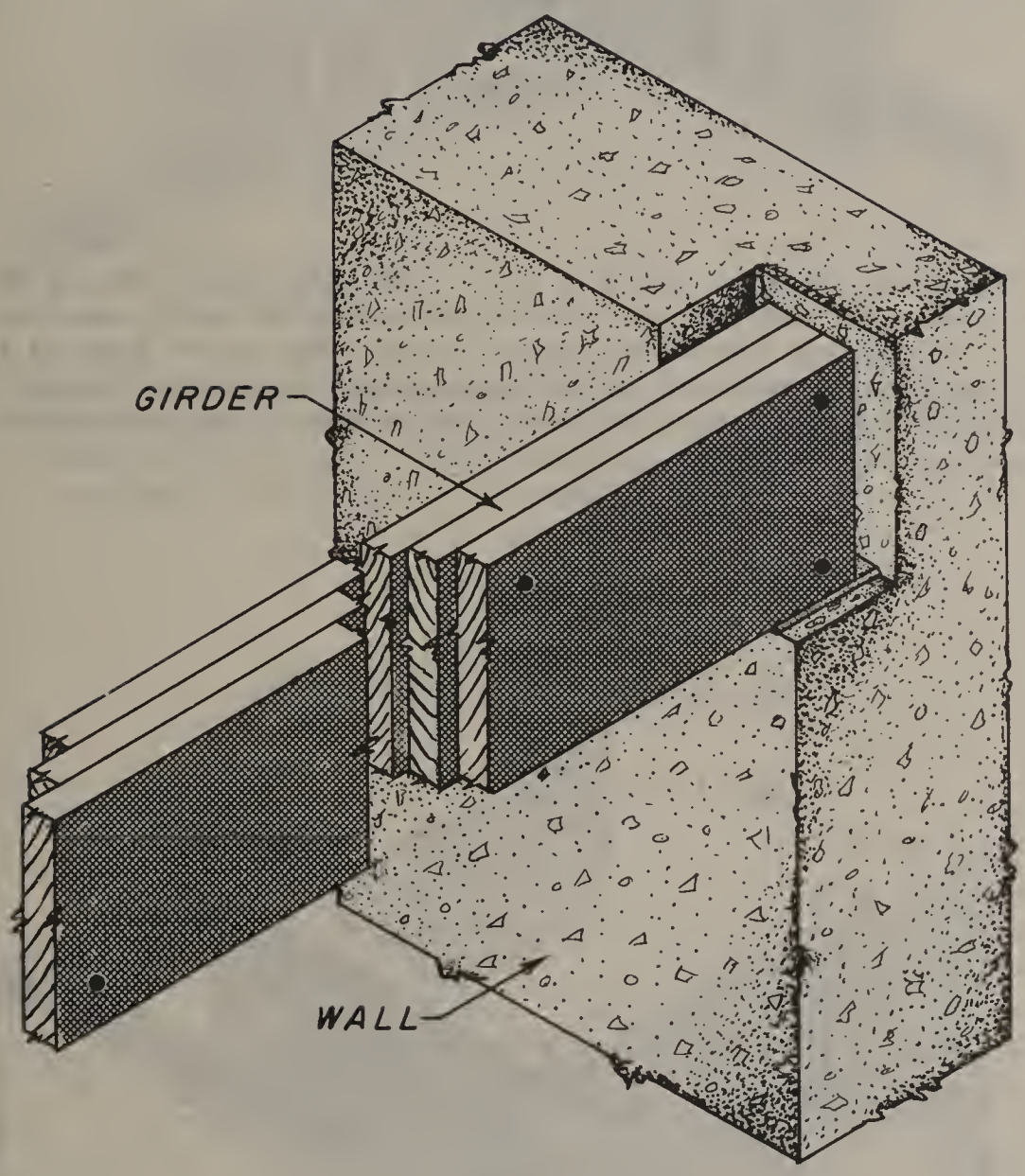


FIGURE 5.—Three-piece girder. Nailed from each side with twenty-penny nails, two near each end of each piece, others staggered with a horizontal distance of 32 inches between nails. Girder joints should occur only at supports. Note: Where a four-piece girder is used, the additional part is nailed to the three-piece girder with twentypenny nails, two near each end of each piece, others staggered with a horizontal distance of 32 inches between nails.

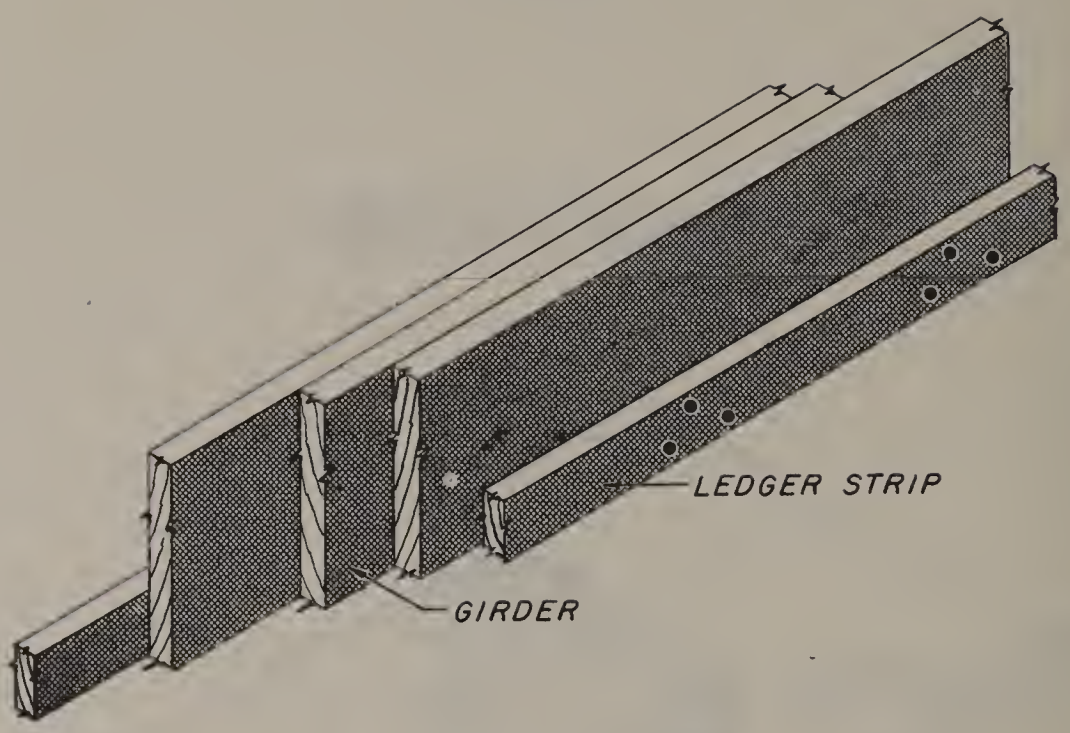


FIGURE 6.—Ledger. Nailed to girder with three twentypenny nails near each joist position. Note: This nailing will safely support a concentrated load of 300 pounds at any point on the floor, or a uniformly distributed load of 50 pounds per square foot over any joist span and spacing ordinarily used in small house construction.

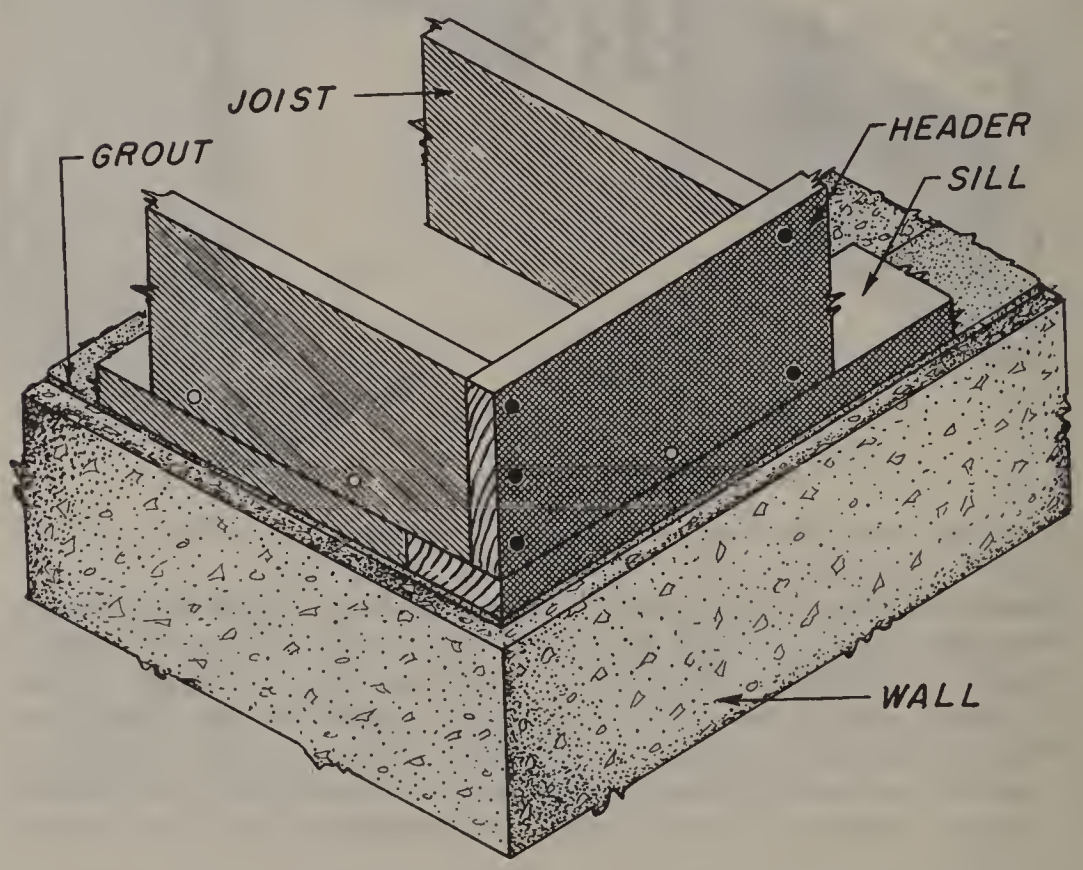


FIGURE 7.—Joist. Header joist nailed to other joists with twenty-penny nails, three to end joist and two to others. End and header joist toenailed to sill with tenpenny nails 16 inches on centers. Note: If diagonal sheathing or plywood sheathing is used and is nailed as shown in figure 32 or figure 34, toenailing to sill is unnecessary except to hold joist in position during construction.

JOIST NOTCHED OVER LEDGER STRIP

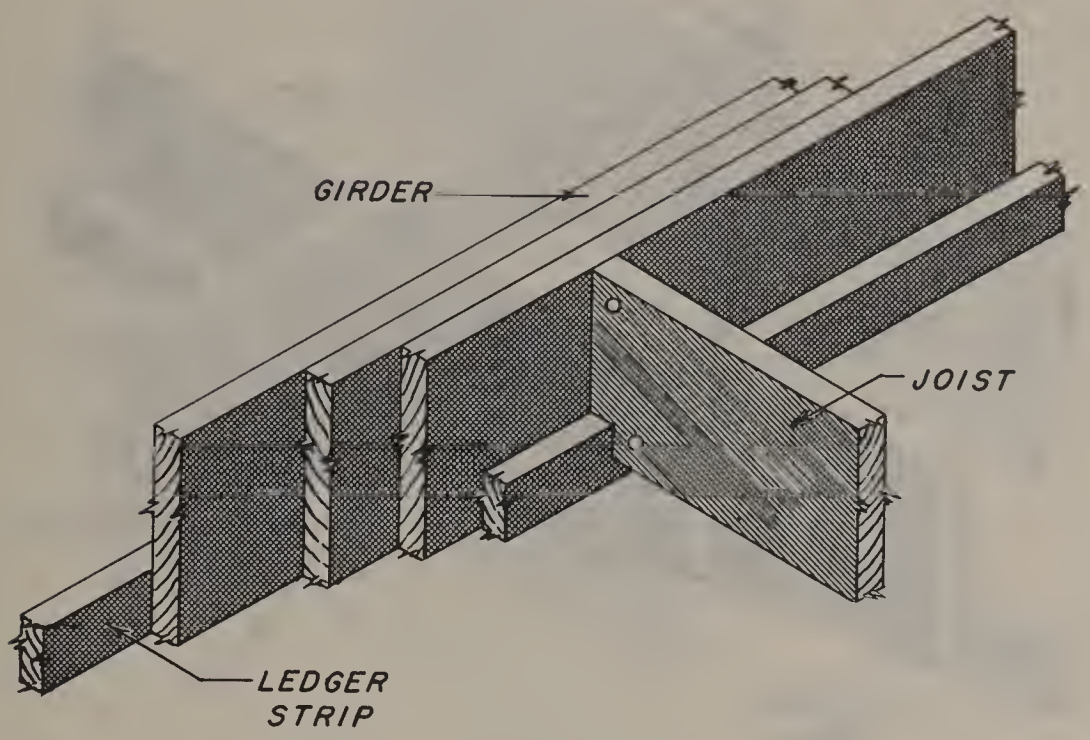


FIGURE 8.—Joist notched over ledger strip. Joist toenailed to girder and to ledger strip with one tenpenny nail as shown or from opposite sides of joist. Note: Notching of joists over the member on which they bear should be avoided whenever possible.

JOIST BEARING ON GIRDER

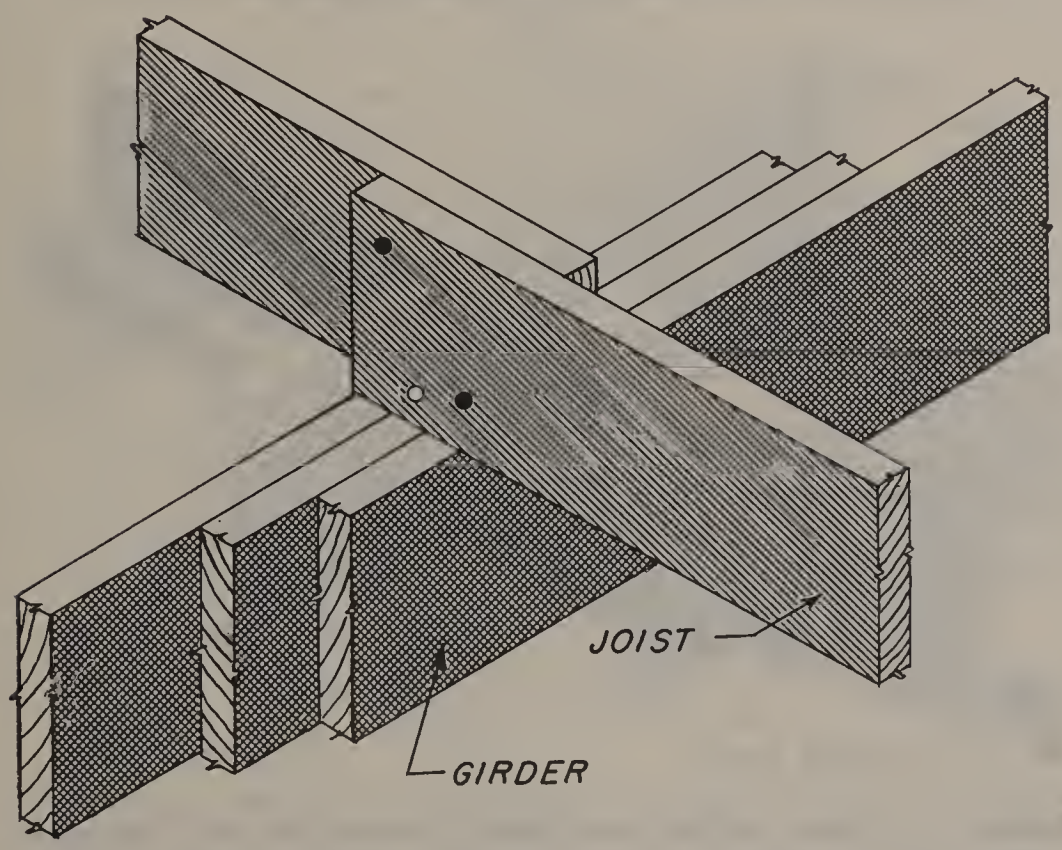


FIGURE 9.—Joist bearing on girder (or partition) Joists nailed together with two tenpenny nails and toenailed to girder with one tenpenny nail on each side of the pair of joists.

OVERLAPPING NOTCHED JOIST BEARING ON LEDGER STRIP

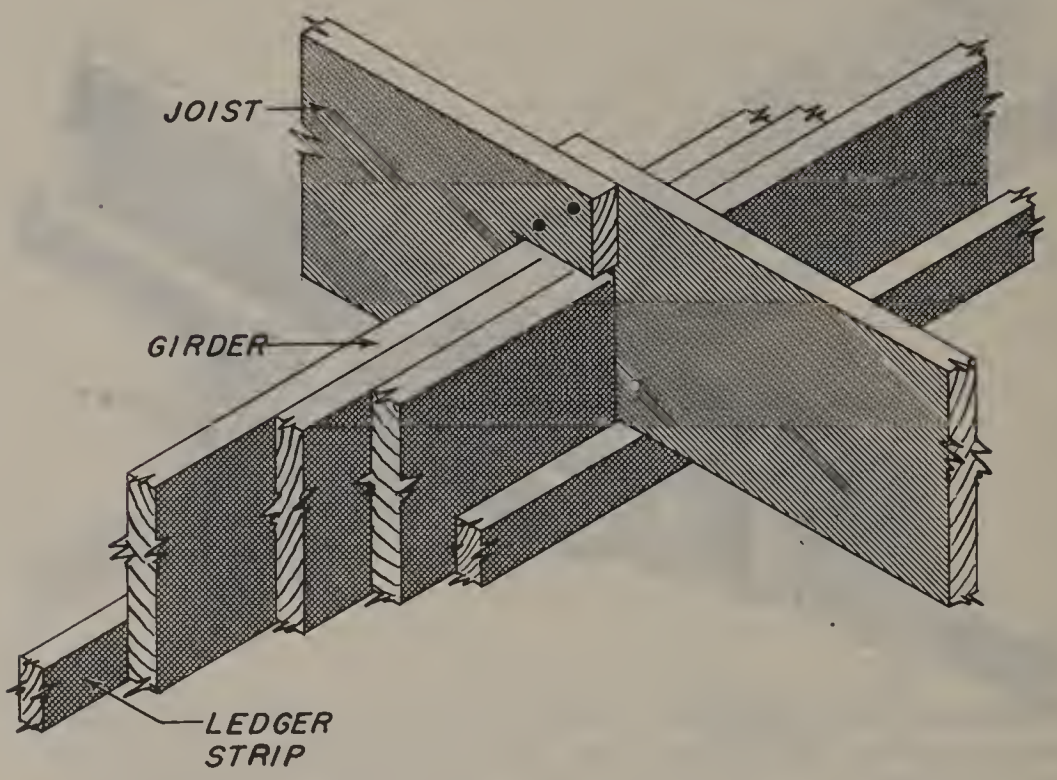


FIGURE 10.—Overlapping joists notched over girder and bearing on ledger strip. Each joist toenailed to girder with one tenpenny nail and joist nailed together with two tenpenny nails. Note: Clearance is provided in the notch over the girder so that the joists bear only on the ledger strip.

NOTCHED JOIST BEARING ON LEDGER STRIP

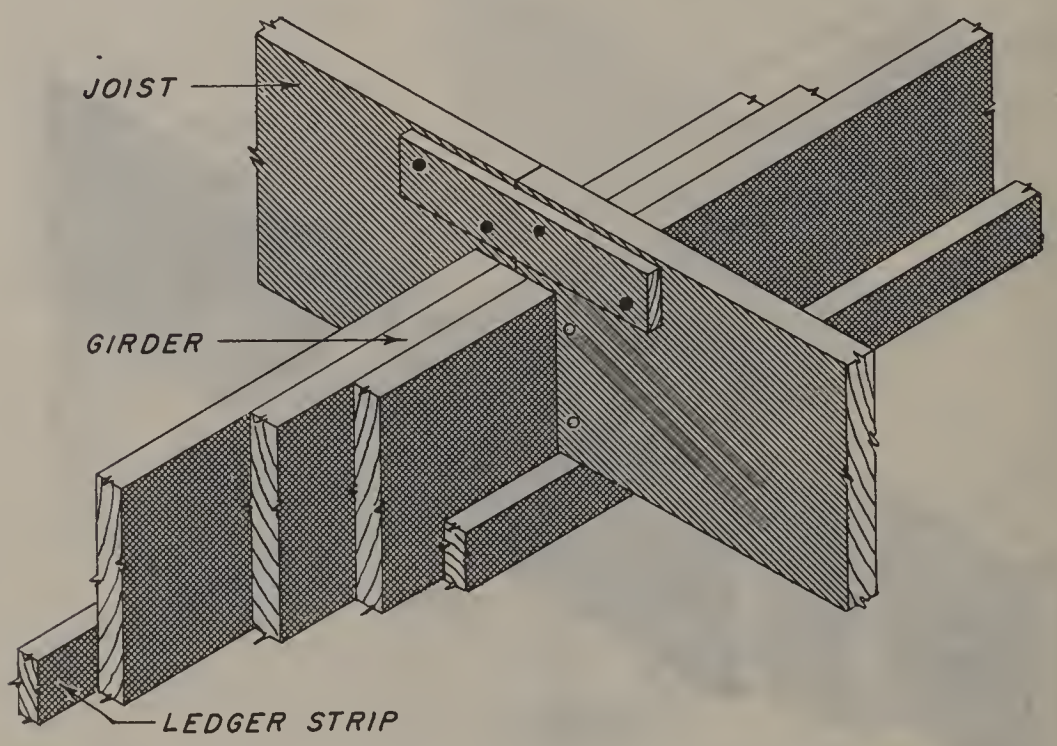


FIGURE 11.—Joists notched over girder and bearing on ledger strip. Each joist toenailed to girder with two tenpenny nails, one near bottom of joist, other on the same or opposite side near top of girder. Wood strip nailed with two eightpenny nails in each joist furnishes additional tie. Note: Clearance is provided in the notch over the girder so that the joists bear only on ledger strip.

BRIDGING

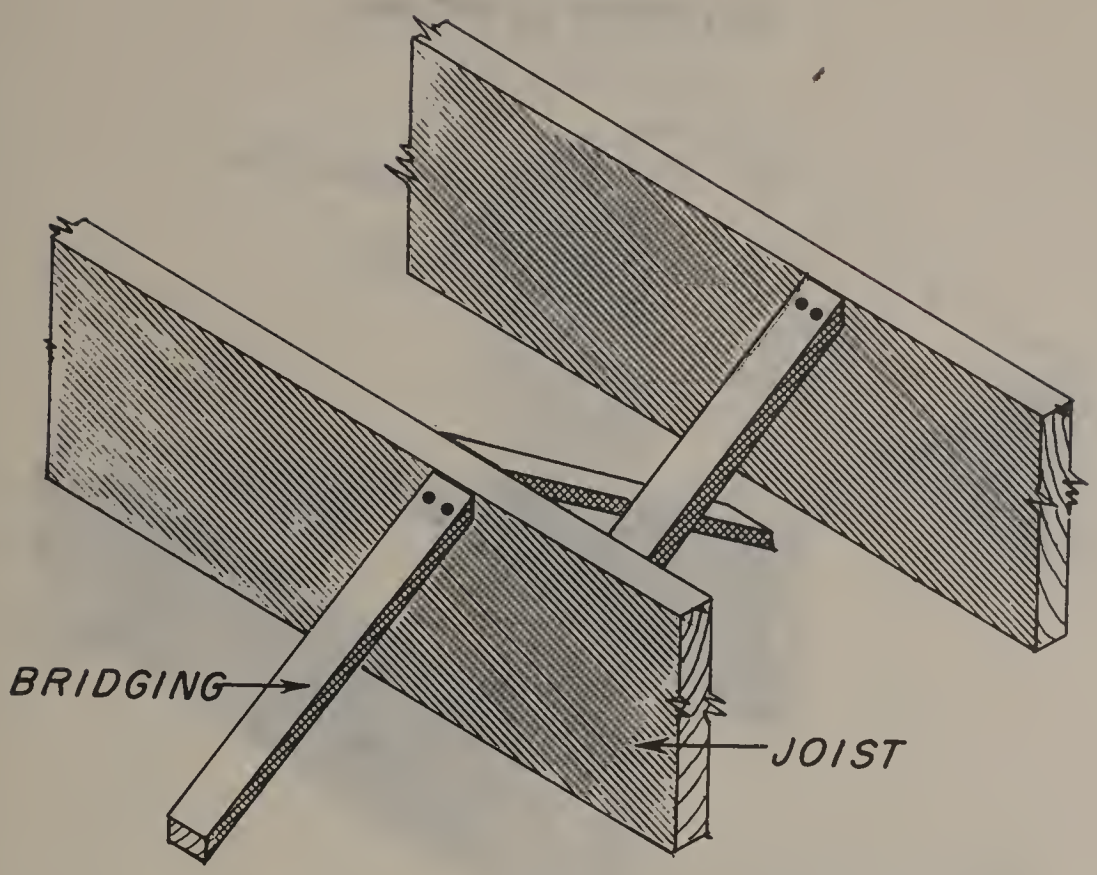


FIGURE 12.—Bridging. Each piece of bridging nailed at each end with two eightpenny nails; nailing of bottom ends deferred until after placement of subfloor and, if possible, until after placement of finished floor, since at that time the tops of joists will have been drawn into better alinement.

SUBFLOOR

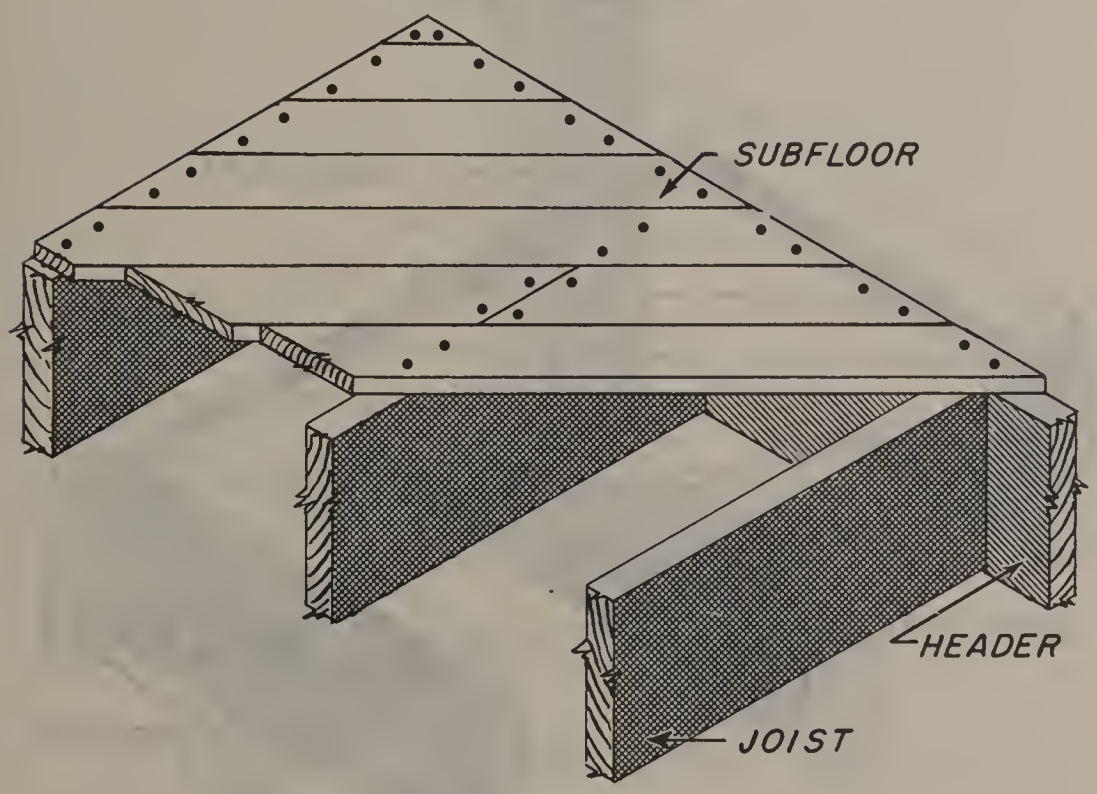


FIGURE 13.—Subfloor (or attic floor). Boards 6 inches or less in width nailed with two eightpenny nails, and wider boards with three eightpenny nails at each crossing of framing member. Note: If subflooring is tongued and grooved on ends and edges, end joints need not be made over joists. Subflooring is preferably laid without cracks between boards. When, however, accumulation of water on the subfloor during construction is likely, it may be desirable to leave sufficient cracks to permit drainage and avoid swelling of the subfloor with resultant warping and cupping.

PLYWOOD SUBFLOOR

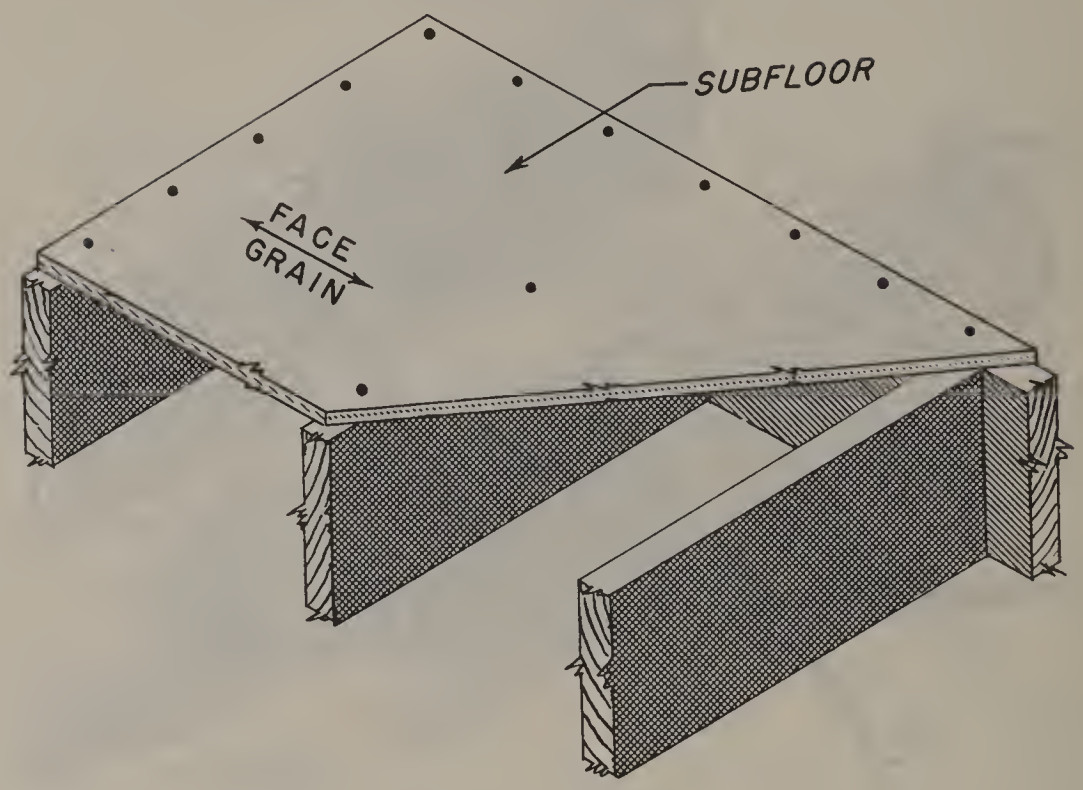


FIGURE 14.—Subfloor. Plywood nailed with eightpenny nails spaced 5 inches along all edges and 10 inches along intermediate members. Note: Plywood subfloor is preferably placed with grain of face plies at right angles to joist.

SOLE PLATE

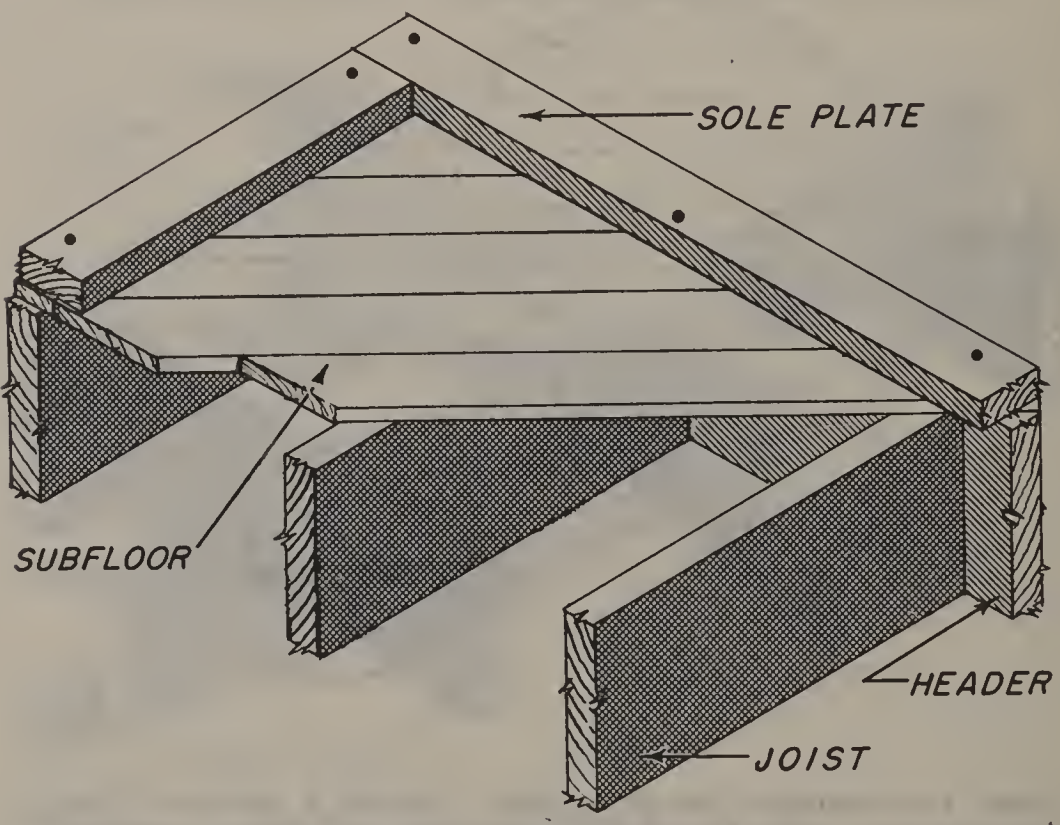


FIGURE 15.—Sole plate. Nailed through subfloor to header joist and joist with sixteenpenny nails staggered. Sole plate over end joist nailed through subfloor to joist with sixteenpenny nails spaced 16 inches on centers. Note: For nailing of plates on which rafters bear, see figures 44 to 46.

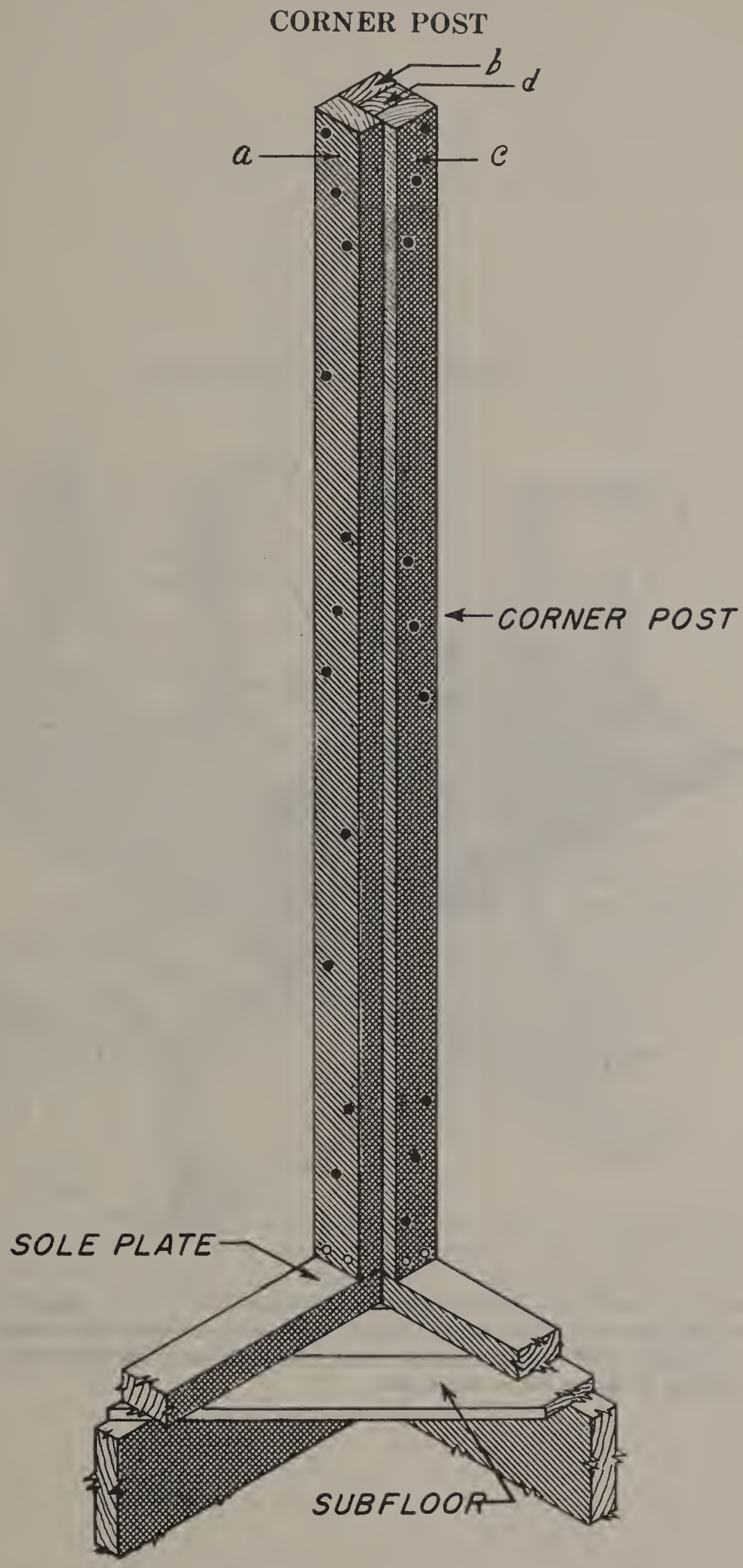


FIGURE 16.—Corner post. Stud *a* nailed to studs *b* and *c* with tenpenny nails staggered 12 inches, and to each filler block *d* with one tenpenny nail. Studs *b* and *c* each nailed to each filler block with three tenpenny nails. Corner post toenailed to sole plate with two eightpenny nails on each face.

STUDS

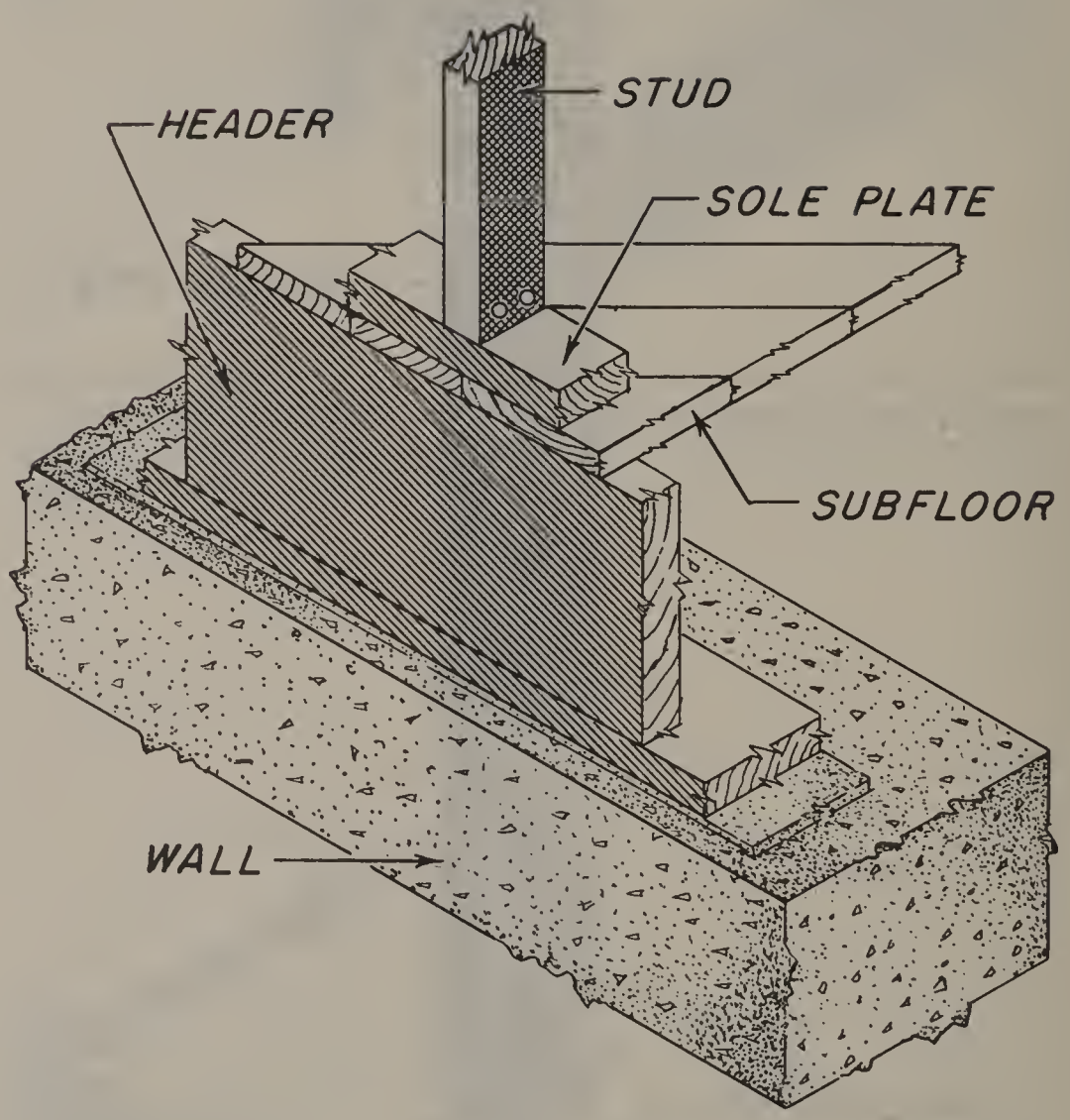


FIGURE 17.—Studs. Toenailed to sole plate with two eightpenny nails on each wide face. Note: One nail on each wide face is sufficient if diagonal boards or plywood is used as sheathing as shown in figure 32 or figure 34.

ANCHORAGE OF STUDS TO SILL

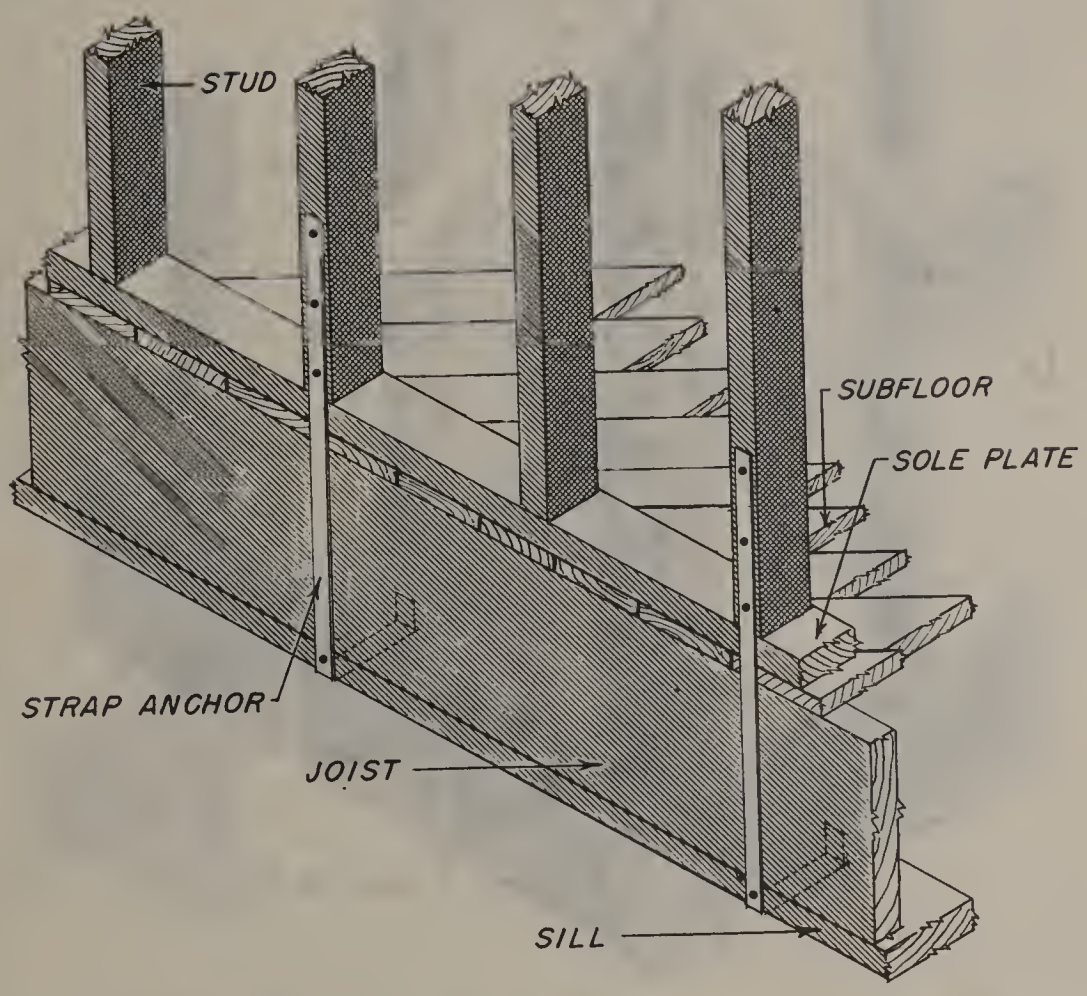


FIGURE 18.—Metal strap anchorage of studs to sill. Strap not less than 22 gage (0.028 inch) in thickness by 1 inch wide nailed to inner and outer edges of sill with one nail, and to outer face of alternate studs with three eightpenny nails. Note: Such anchorage is not needed if diagonal boards or plywood is used as wall sheathing and is nailed as shown in figure 32 or figure 34.

TOP PLATE AND BRACING

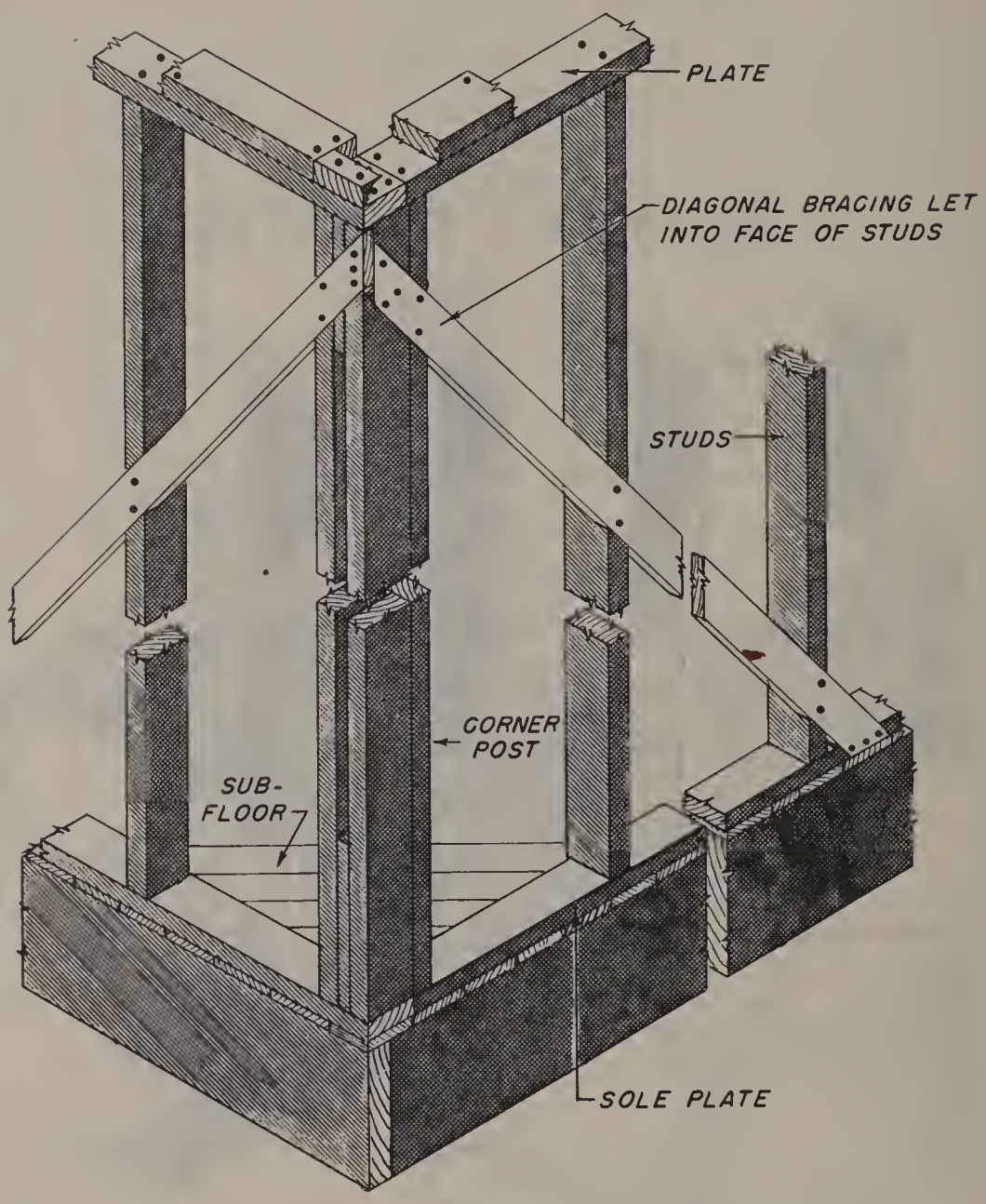


FIGURE 19.—Top plate and let-in bracing. Lower part of plate nailed to each stud and corner post with two sixteenpenny nails. Upper part nailed to lower with tenpenny nails, two near the ends of each piece, others staggered 16 inches. Braces fitted into notches in faces of frame members (including fire stops or headers) and nailed at each crossing stud with not less than two tenpenny nails, and at ends with three tenpenny nails. Note: When window or door openings near corners interfere with placing braces at corners, braces may be placed in other available wall spaces and nailed to top and bottom plates and to studs. At least two braces in each wall are desirable at opposite inclinations and approximately 45° to the horizontal. When sheathing boards are placed diagonally, figure 32, or plywood is used as sheathing, figure 34, let-in bracing is not necessary.

RIBBON

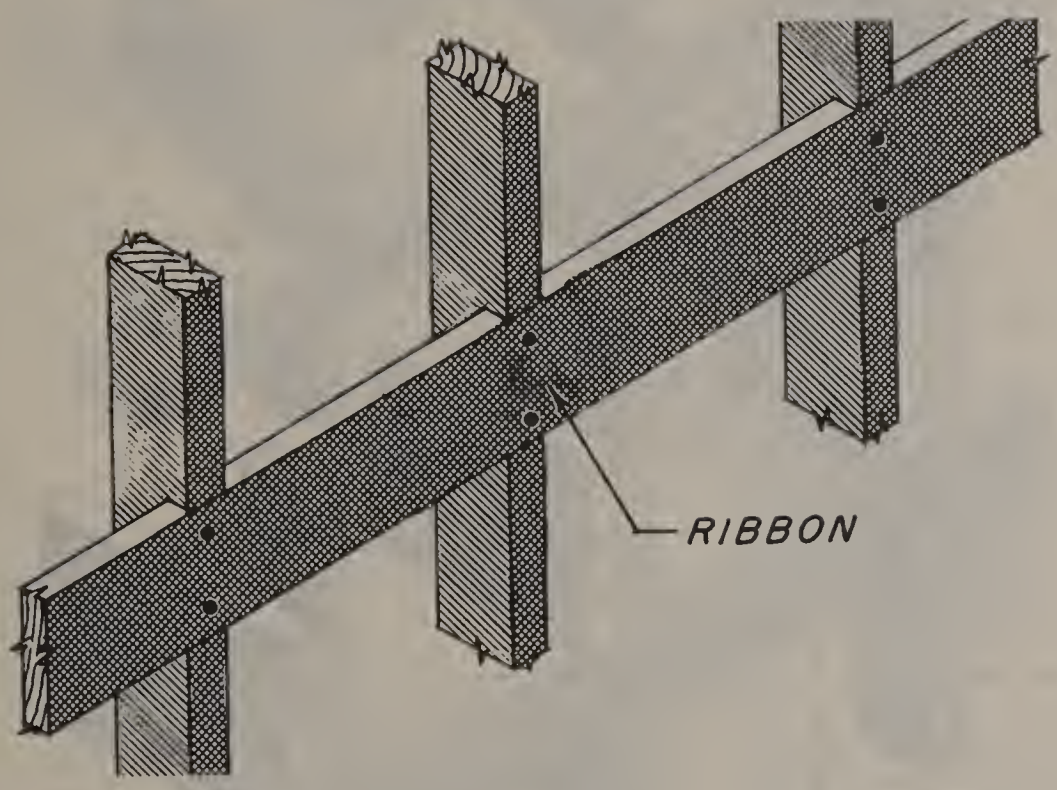


FIGURE 20.—Ribbon. Two eightpenny nails through ribbon into each stud.

JOIST BEARING ON RIBBON

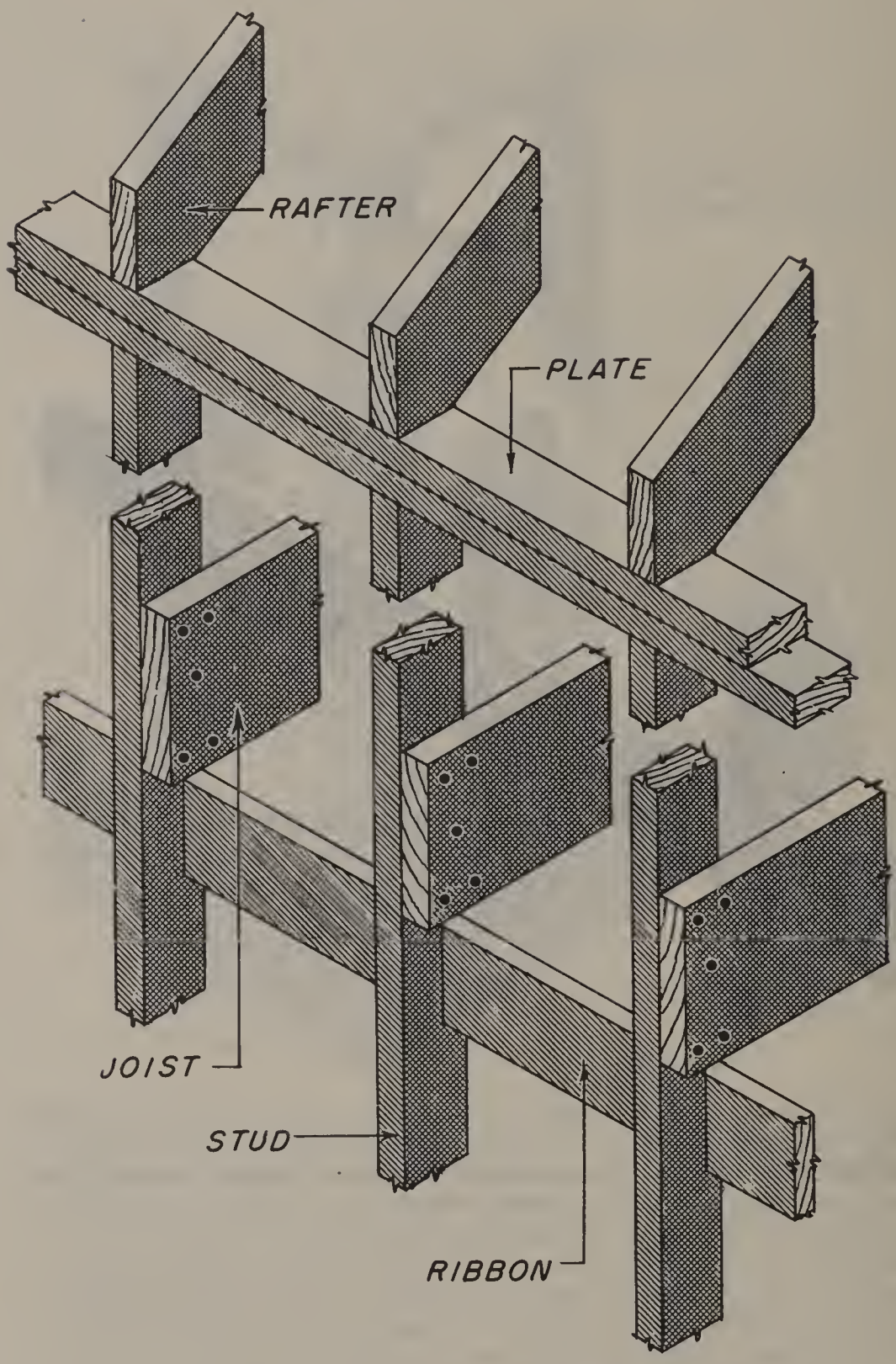


FIGURE 21.—Joist bearing on ribbon. Joist nailed to each stud with five tenpenny nails. Note: When there is a full story above ribbon, two instead of five nails will be sufficient since ceiling joists will then be available to resist the thrust of rafters.

FLOOR OPENING

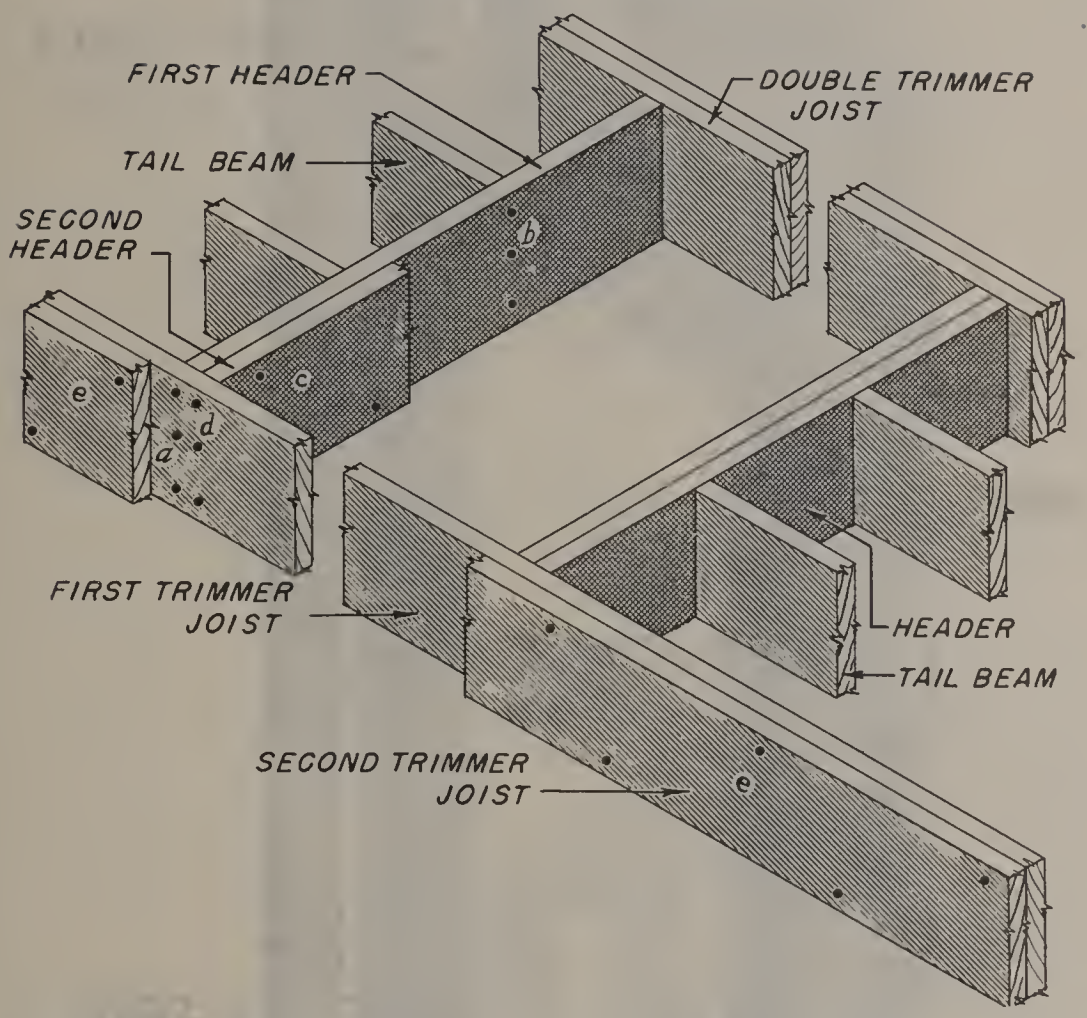


FIGURE 22.—Floor opening. *a*. Nail through first trimmer joists into ends of first headers with three twentypenny nails. *b*. Nail through first headers into ends of tail beams with three twentypenny nails. *c*. Nail second headers to first with sixteenpenny nails spaced 6 inches longitudinally and placed near top and near bottom alternately. *d*. Nail through first trimmer into ends of second header with three twentypenny nails. *e*. Nail second trimmer joist to first with sixteenpenny nails spaced 6 inches longitudinally and placed near top and near bottom alternately. Note: This nailing will support a concentrated load of 300 pounds at any point on the floor, or uniformly distributed load of 50 pounds per square foot with any spacing and span of tail beams ordinarily used in small house construction, provided the length of floor opening is parallel to the length of the joist. If the length of opening is at right angles to the joists, excessive loading may be brought to the junction of headers with trimmers. Anticipated loads should be checked and increased nailing or additional supports provided at these junctions if neeeded for the expected loads.

DOOR OPENING

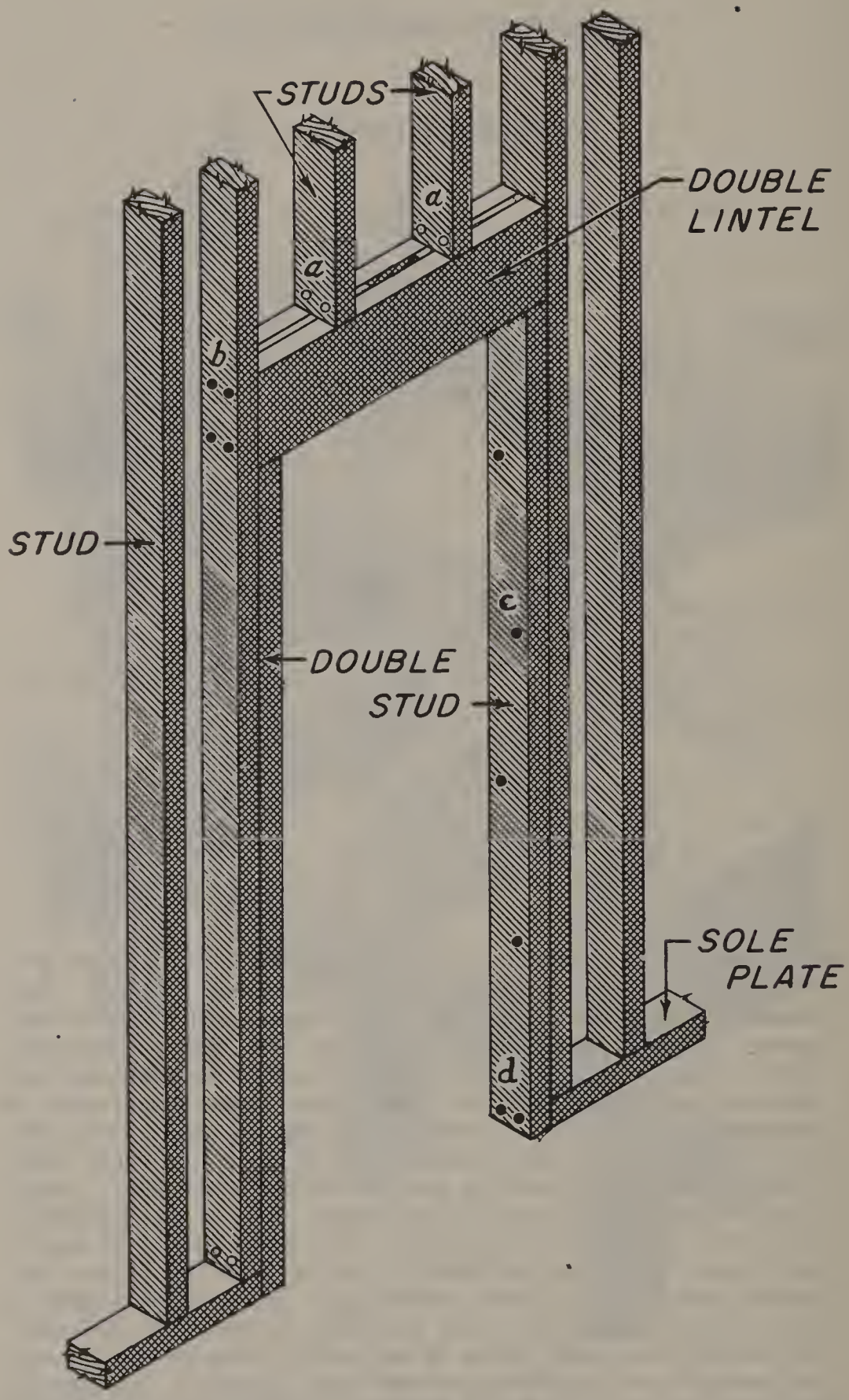


FIGURE 23.—Door opening in wall or partition. *a*. Studs above opening toenailed to each part of lintel with one tenpenny nail. *b*. Long studs nailed to ends of each part of lintel with two tenpenny nails and toenailed to sole plate with two tenpenny nails. *c*. Double studs nailed together with tenpenny nails spaced 16 inches and staggered as shown. *d*. Studs alongside opening nailed into end of sole plate with two tenpenny nails.

WINDOW OPENING

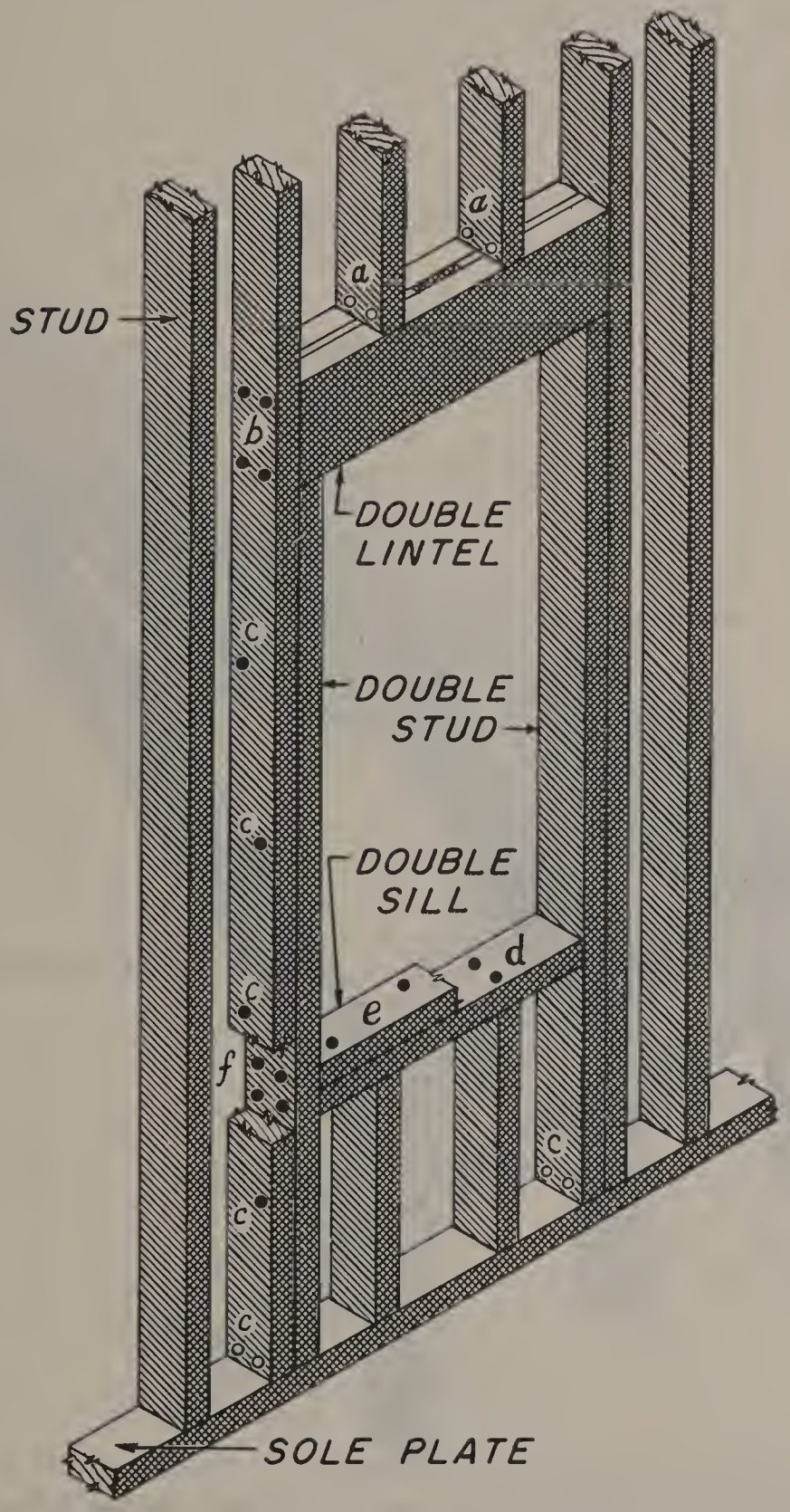


FIGURE 24.—Window opening. *a*. Studs above opening toenailed to each part of lintel with one tenpenny nail. *b*. Long studs nailed to ends of each part of lintel with two tenpenny nails. *c*. Double studs nailed together with tenpenny nails spaced 16 inches and staggered as shown, and toenailed to sole plate with four tenpenny nails, two from each side. *d*. Lower part of sill member nailed to end of each stud below it with two tenpenny nails. *e*. Upper part of sill member nailed to lower with tenpenny nails spaced 8 inches and staggered as shown. *f*. Studs alongside opening nailed to ends of each part of sill member with two tenpenny nails.

JACK RAFTER

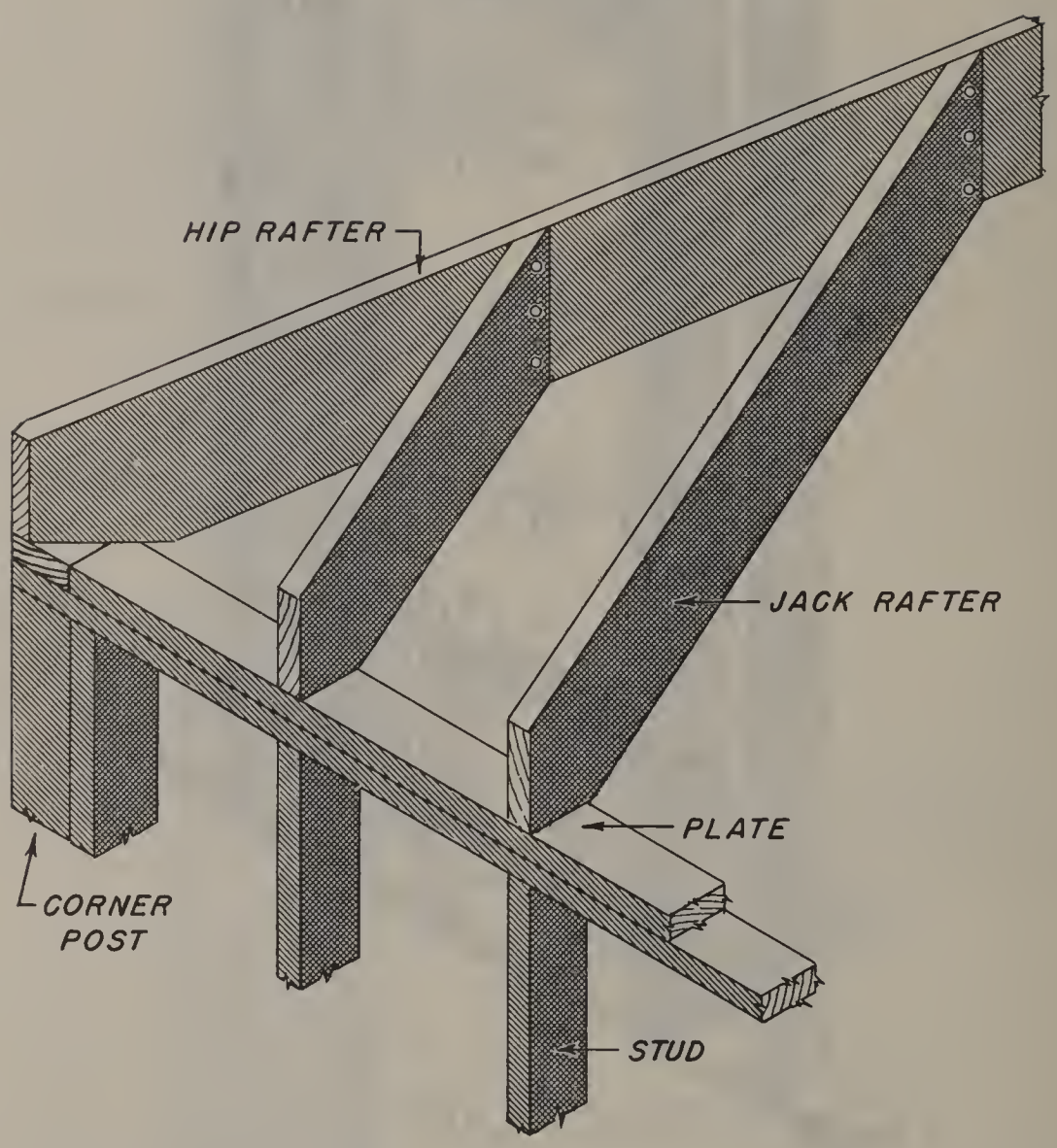


FIGURE 25.—Jack rafter. Jack rafter toenailed to hip rafter with three tenpenny nails.

ROOF PEAK

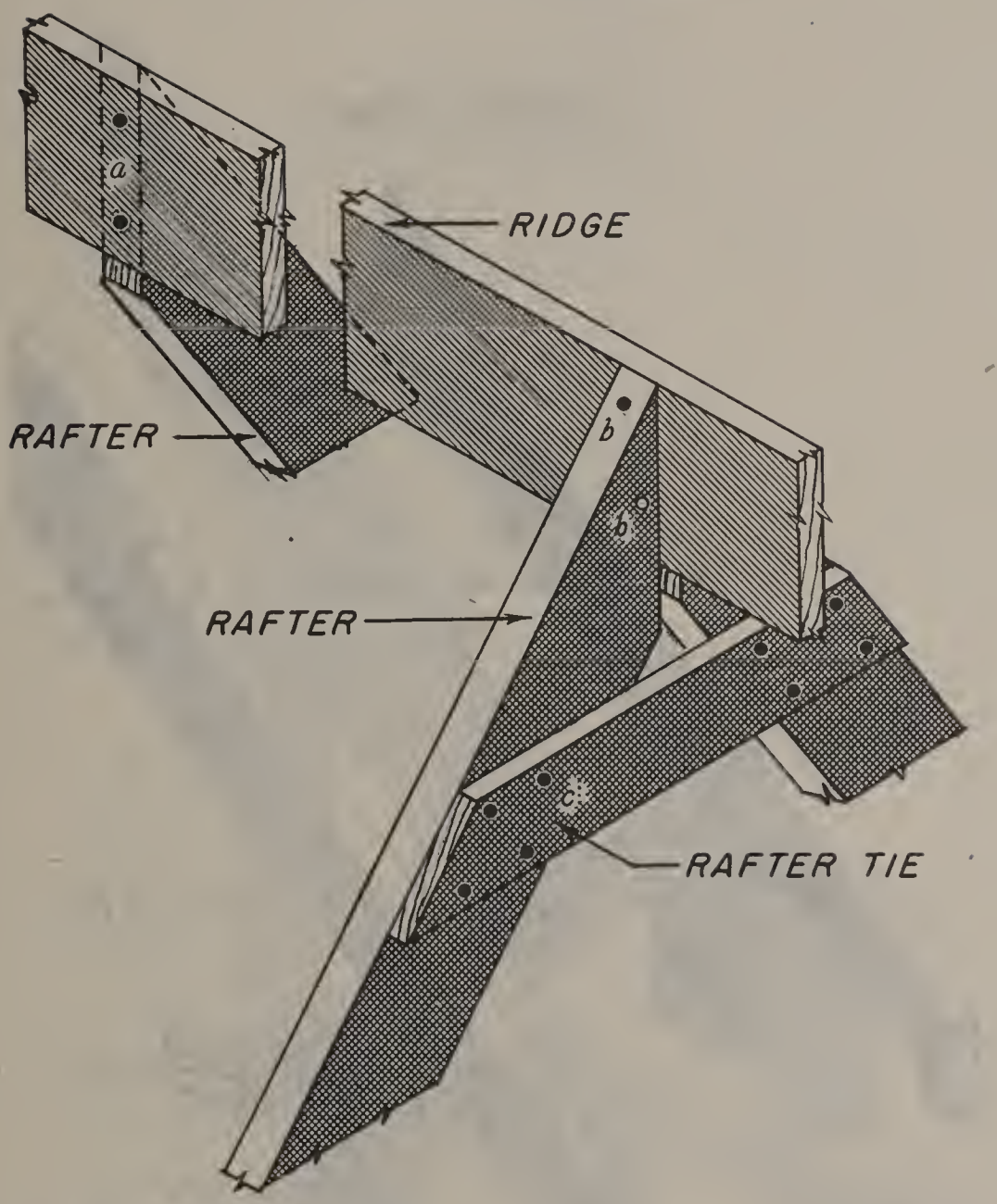


FIGURE 26.—Roof peak. *a*. Ridge nailed to first rafter of pair with two nails (tenpenny for 1-inch ridge or sixteenpenny for 2-inch ridge). *b*. Second rafter of pair nailed through its top edge to ridge with one tenpenny nail and toenailed to ridge with one tenpenny nail. *c*. Rafter tie or collar beam placed near peak and nailed to each rafter with four tenpenny nails. Such a rafter tie is desirable to resist the spreading tendency resulting from wind action, whether or not a ridge is used.

RAFTER ENDS

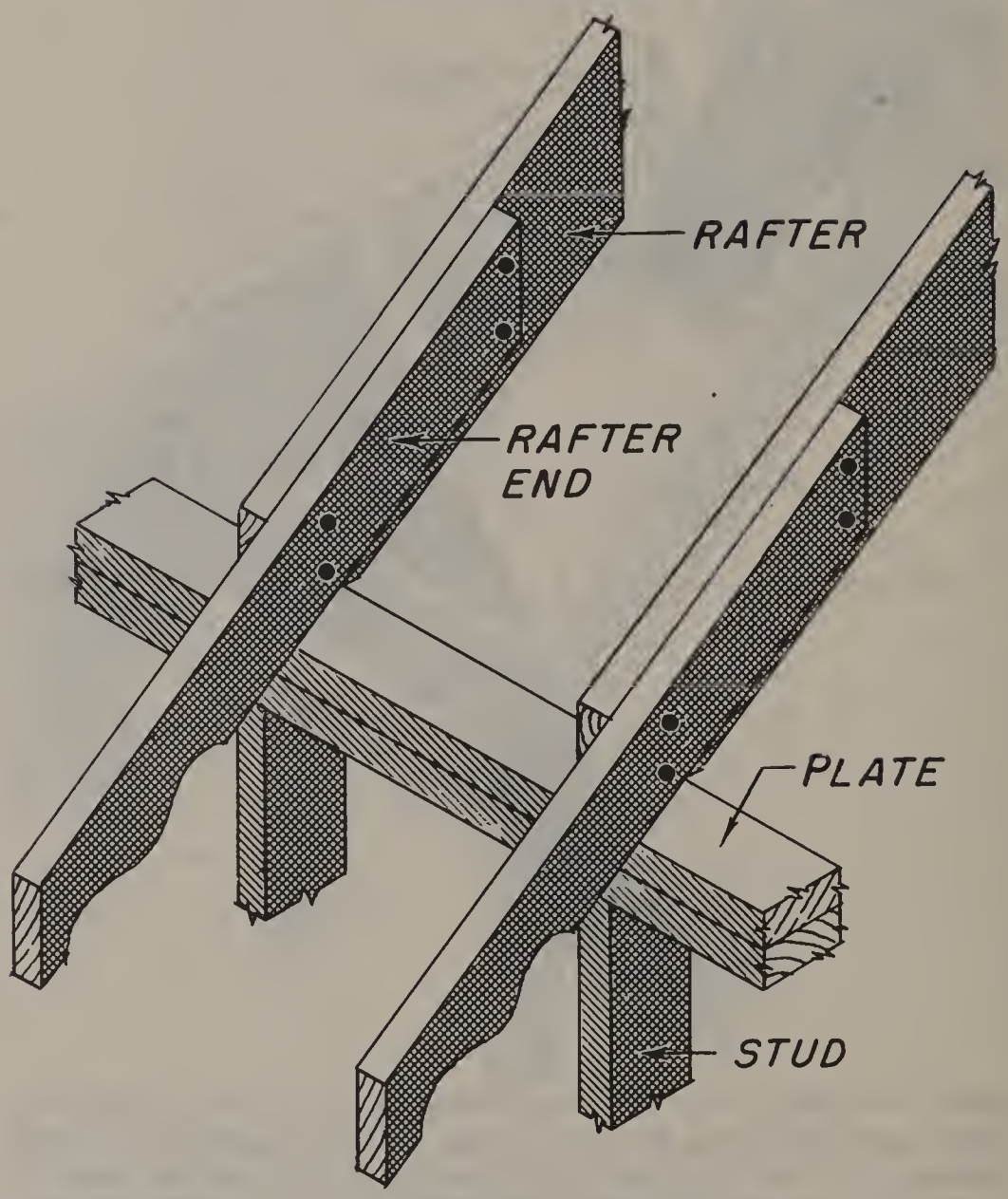


FIGURE 27.—Rafter ends. Nailed to rafter with four tenpenny nails.

NOTCHED GABLE STUD

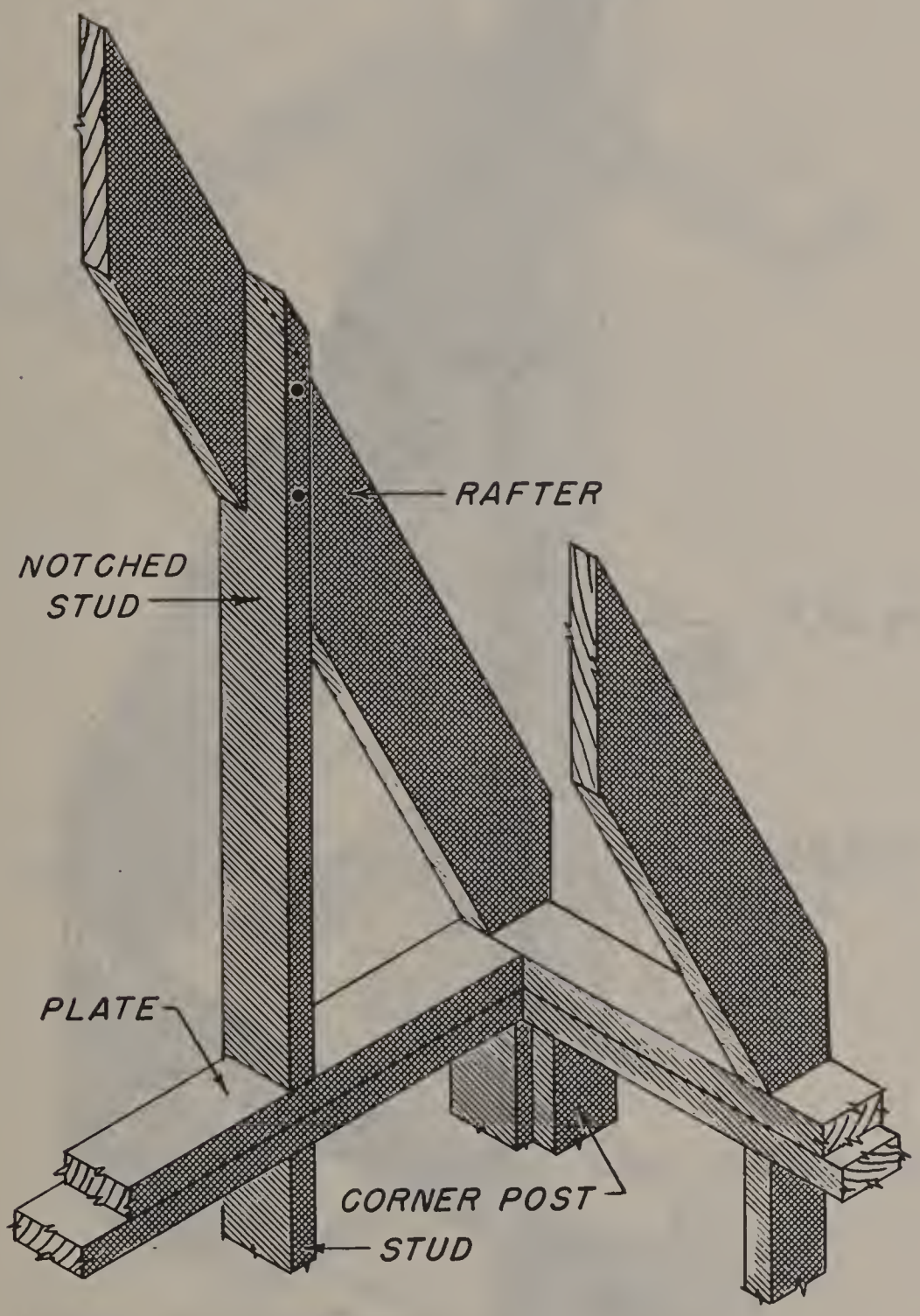


FIGURE 28.—Notched gable stud. Stud nailed to rafter with two tenpenny nails.

BEVELED GABLE STUD

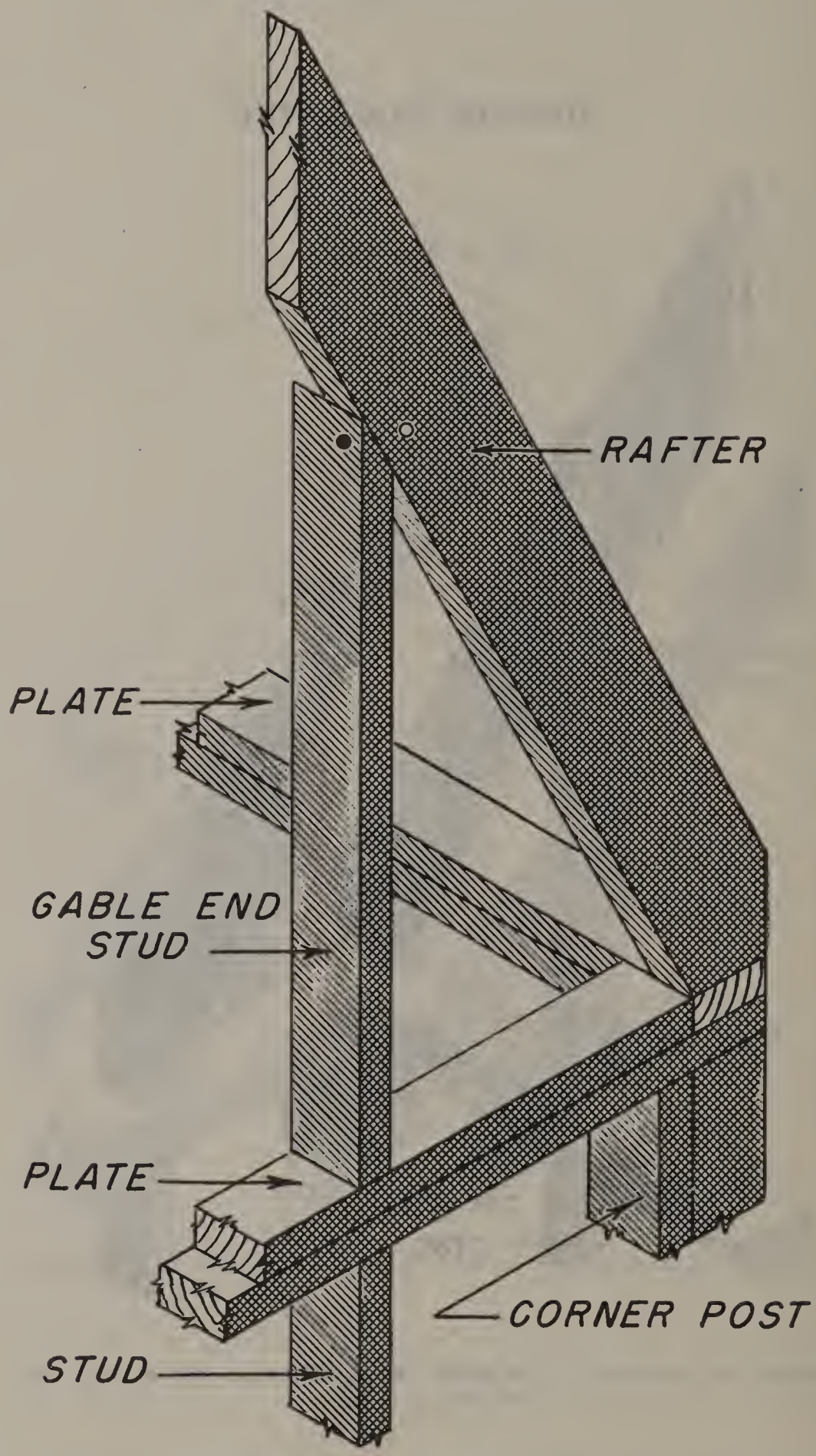
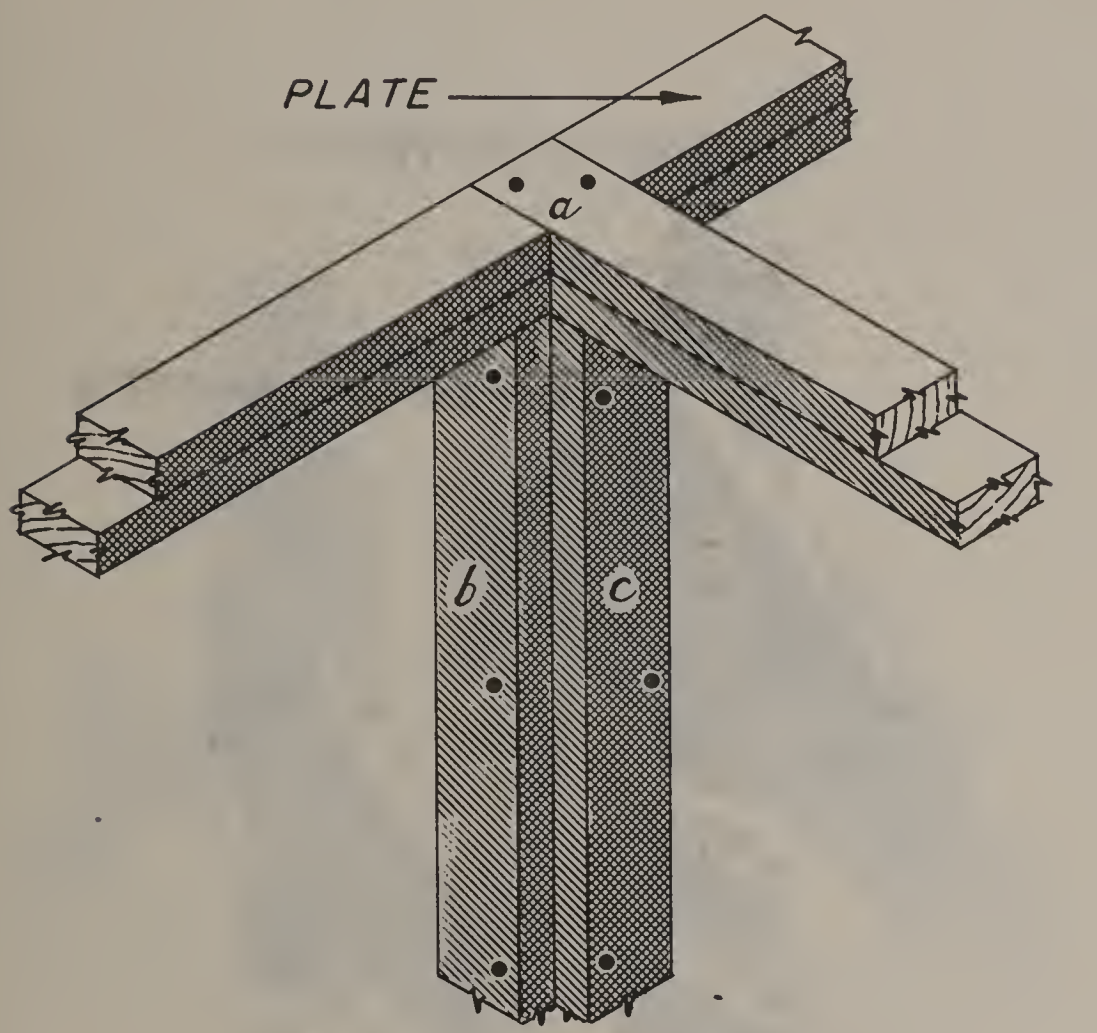


FIGURE 29.—Beveled gable stud. Rafter toenailed to stud and stud nailed to rafter with tenpenny nails.

PARTITION-WALL CONNECTION



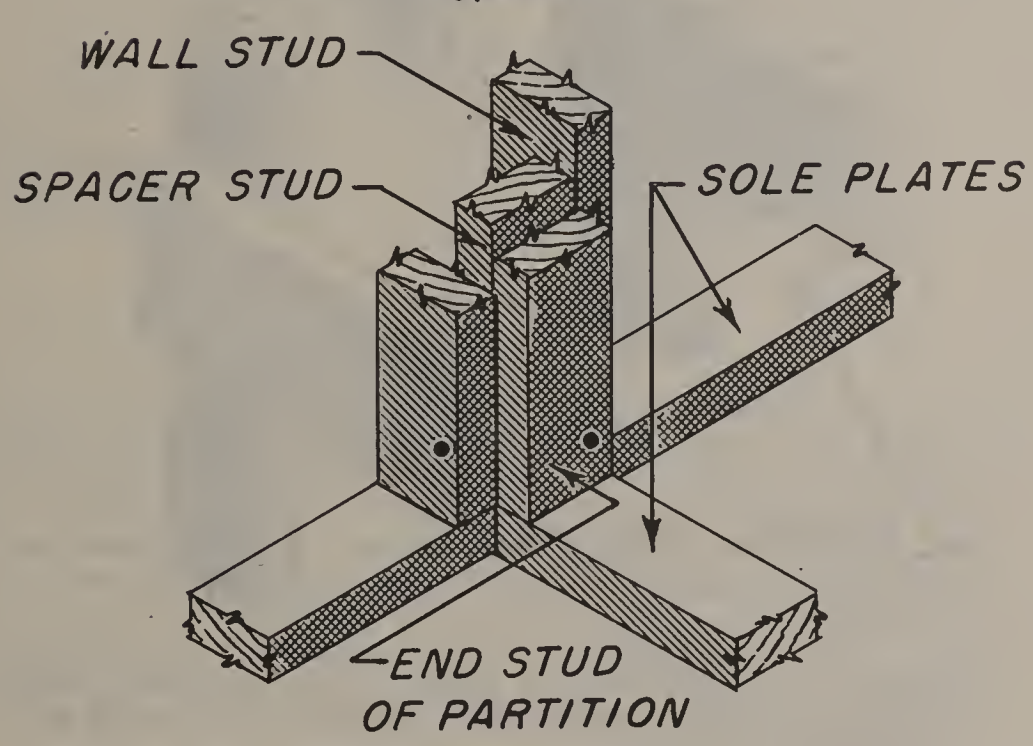


FIGURE 30.—Connection of partition to wall. *a*. Upper member of partition plate nailed to lower (continuous) member of wall plate with two sixteenpenny nails. *b*. Wall studs nailed to spacer stud with sixteenpenny nails 12 inches on centers. *c*. End stud of partition nailed to spacer stud with tenpenny nails staggered with a vertical distance of 12 inches between nails.

PORCH CONNECTION

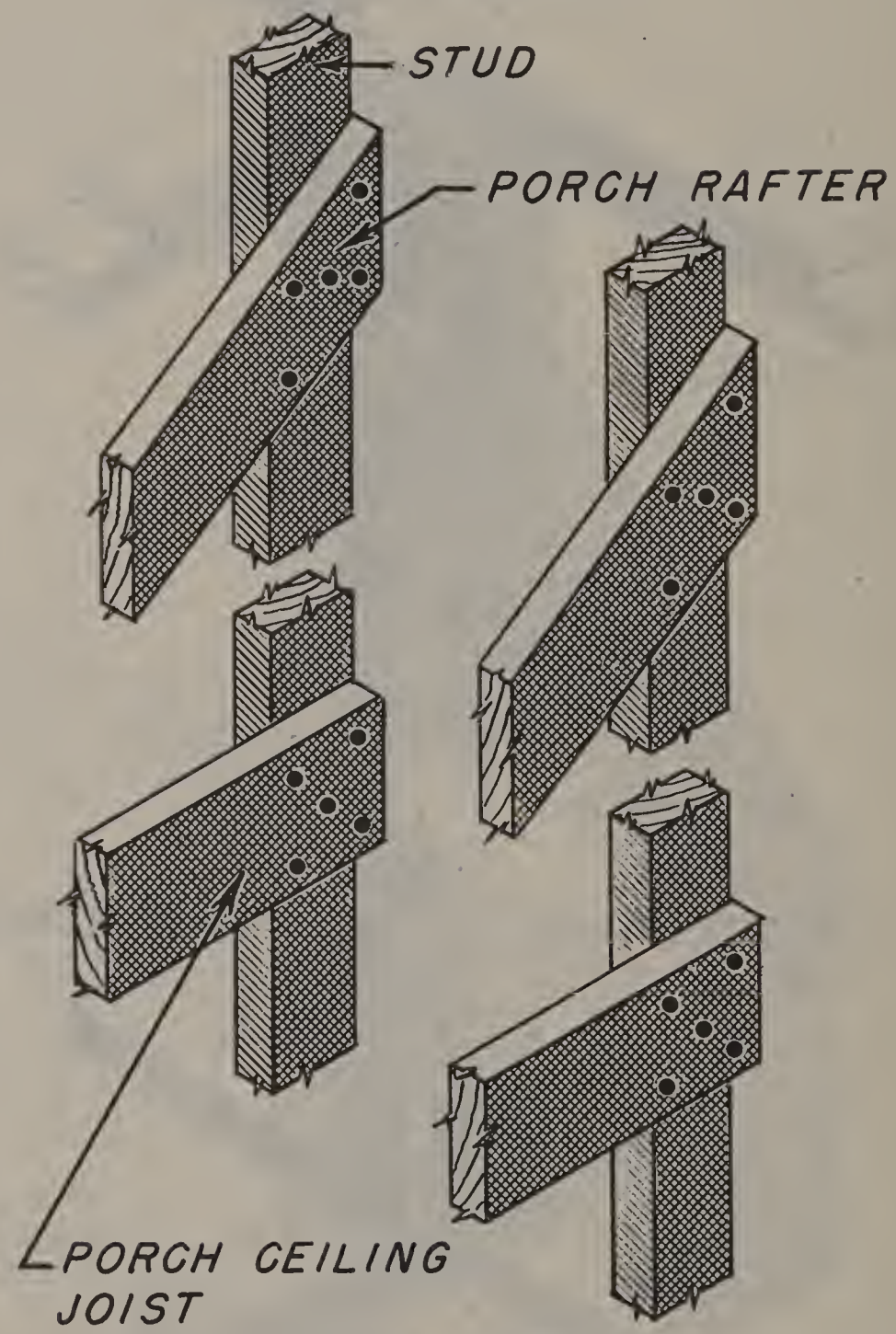


FIGURE 31.—Connection of porch roof to house. Porch rafters and ceiling joists nailed to studs of the house with five tenpenny nails.

DIAGONAL WALL SHEATHING

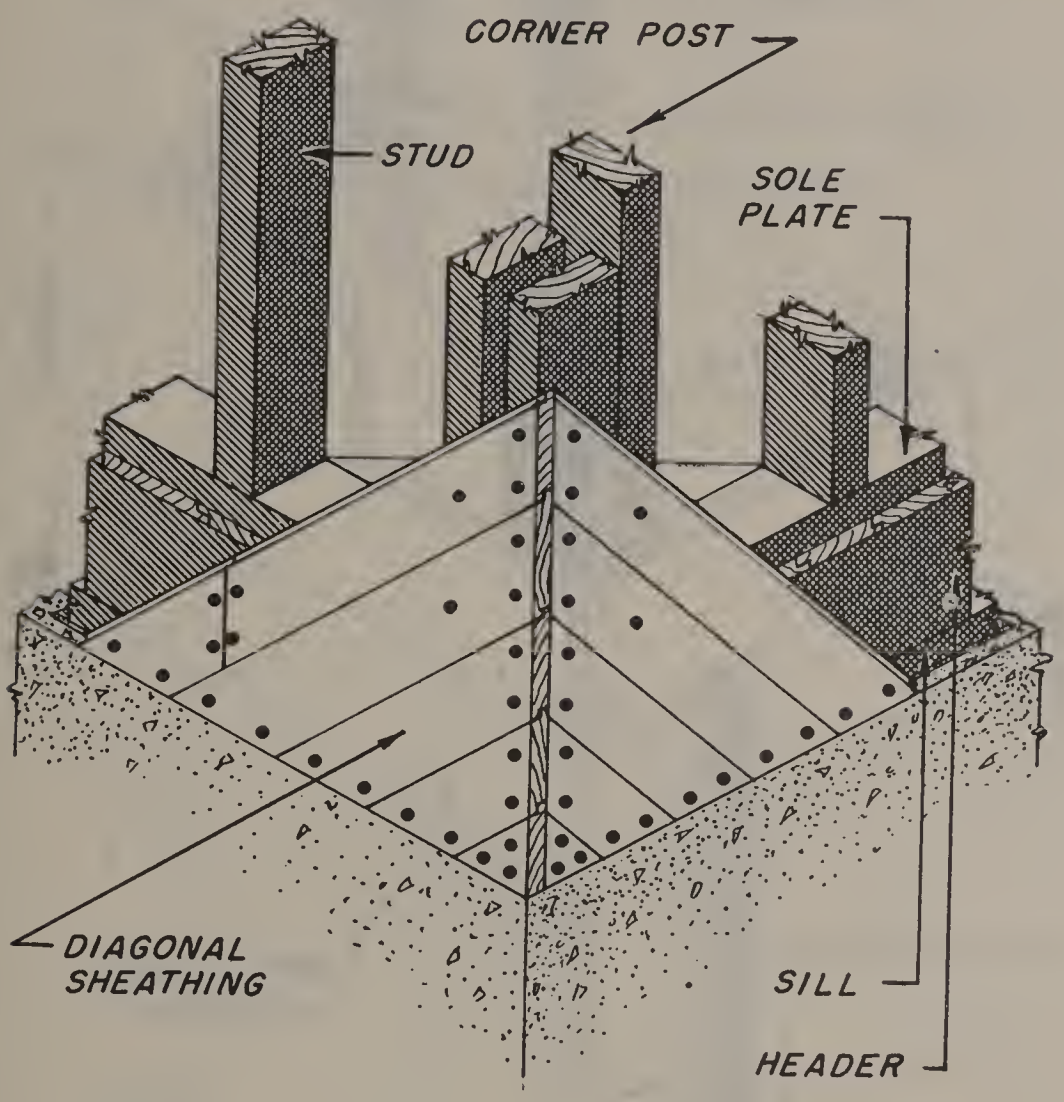


FIGURE 32.—Diagonal wall sheathing. Use eightpenny nails. For boards 8 inches and less in width, use two nails at each end of each board, two nails through each board into studs, and three nails through each board into the corner post assembly. For wider boards use an additional nail at each of these points. Joints in adjacent runs of sheathing boards should preferably be separated by at least two stud spaces. Many of the houses that were undamaged by the 1926 and 1928 Florida hurricanes were diagonally sheathed. In addition to affording high resistance to the racking forces engendered by windstorms and earthquakes, diagonal sheathing nailed as specified effectively ties together sills, joists, plates, and studs. Note: If boards are tongued and grooved, end joints need not be made over studs.

HORIZONTAL WALL SHEATHING

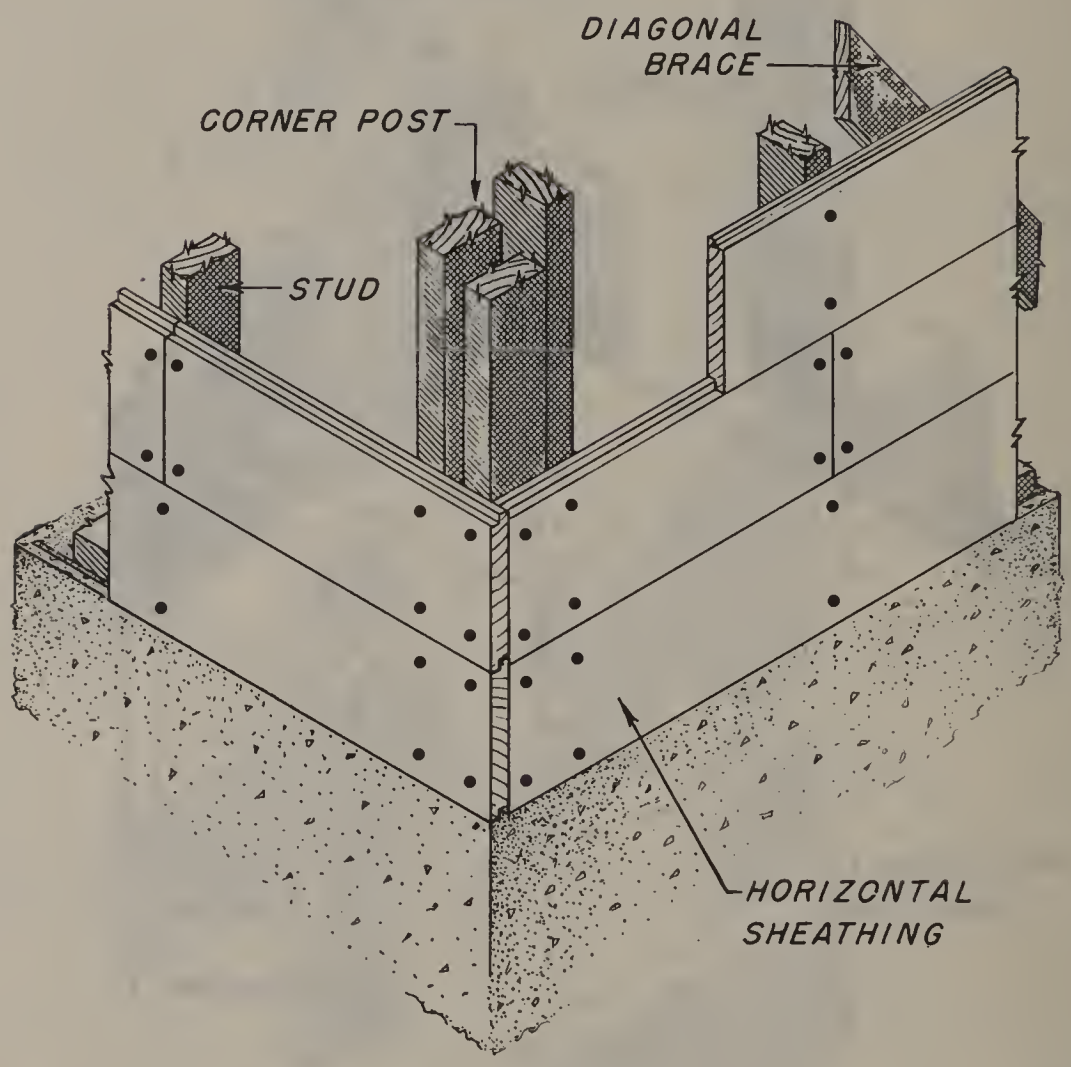


FIGURE 33.—Horizontal wall sheathing. Boards 8 inches or less in width nailed to framing members with one eightpenny nail near each edge of the board. Wider boards nailed with three eightpenny nails, one near each edge and one near the middle of the width. Note: It is desirable that sheathing be of such widths and so placed that junctions between sill and joist and between joist and studs are each spanned by the nails in a single board. This ties other framing members to the sill, although less effectively than diagonal sheathing (fig. 32) or plywood (fig. 34).

PLYWOOD WALL SHEATHING

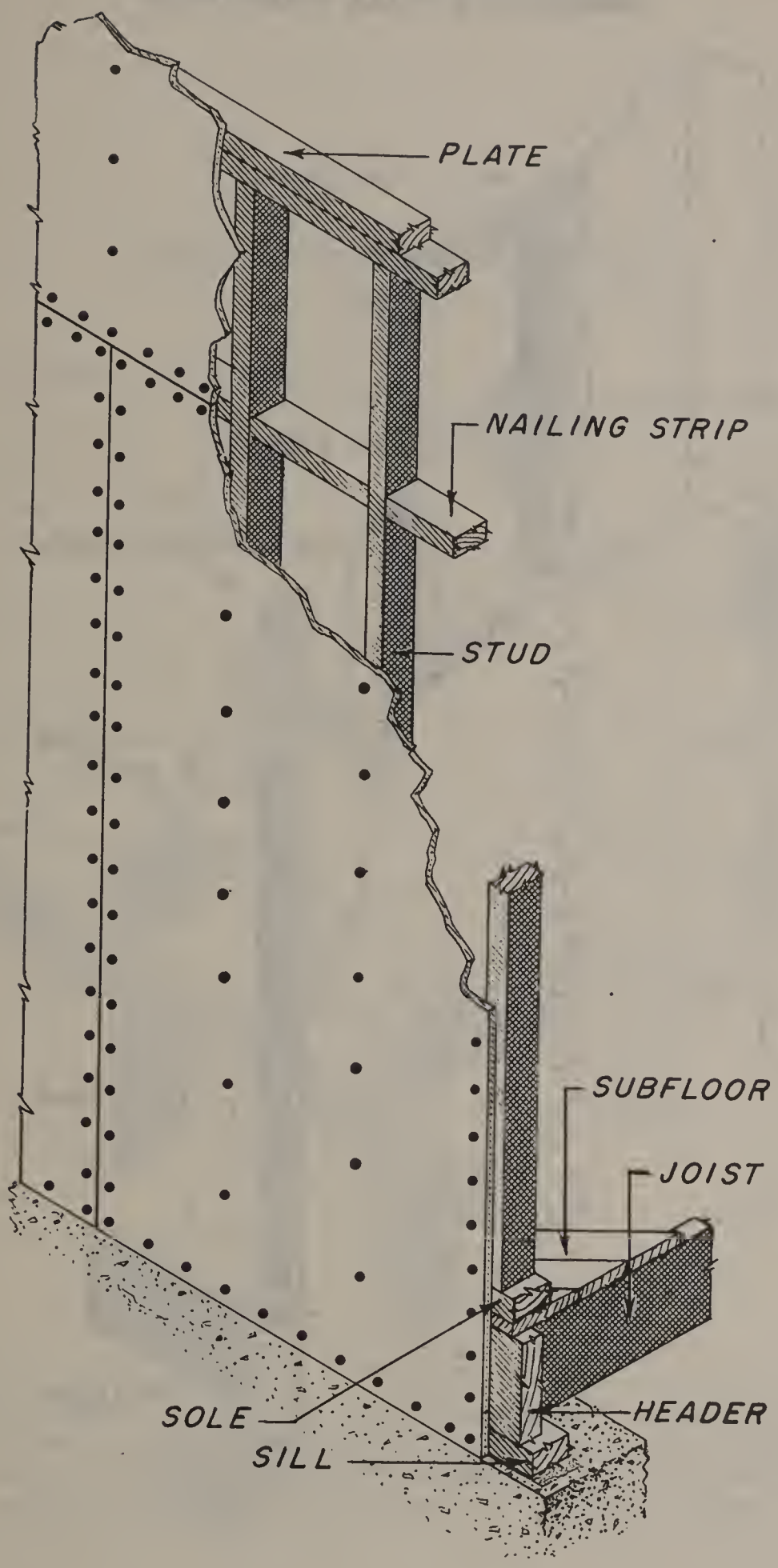


FIGURE 34.—Plywood wall sheathing. Plywood less than one-half inch in thickness nailed with sixpenny nails spaced 5 inches on centers along edges and 10 inches on intermediate framing members. Plywood one-half inch or thicker nailed with eight-penny nails at same spacings. Note: Vertical joints between plywood sheets should not be on the same stud or joist in succeeding rows of sheathing. For the horizonal joints nailing strips are set between the studs and nailed to them.

FIBERBOARD WALL SHEATHING

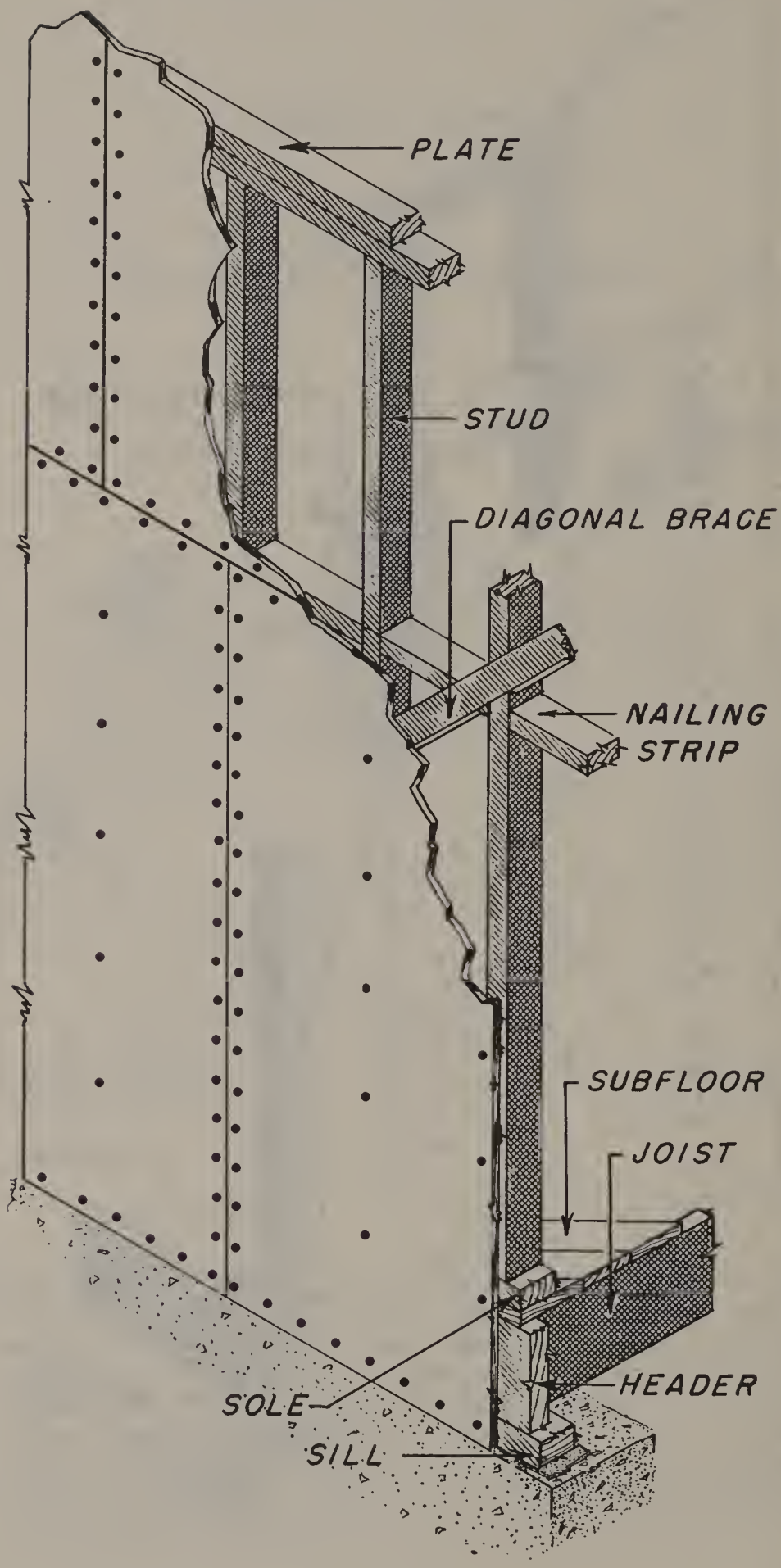


FIGURE 35.—Fiberboard wall sheathing. Nail with eight-penny rust-resisting nails spaced 6 inches around edges and 10 inches on intermediate framing members. Diagonal bracing nailed in accordance with figure 19. Note: Vertical joints between fiberboard sheets should not be on the same stud or joist in succeeding rows of sheathing. To receive the nails at the horizontal joints, nailing strips are set between the studs or joists and nailed to them.

HORIZONTAL ROOF SHEATHING

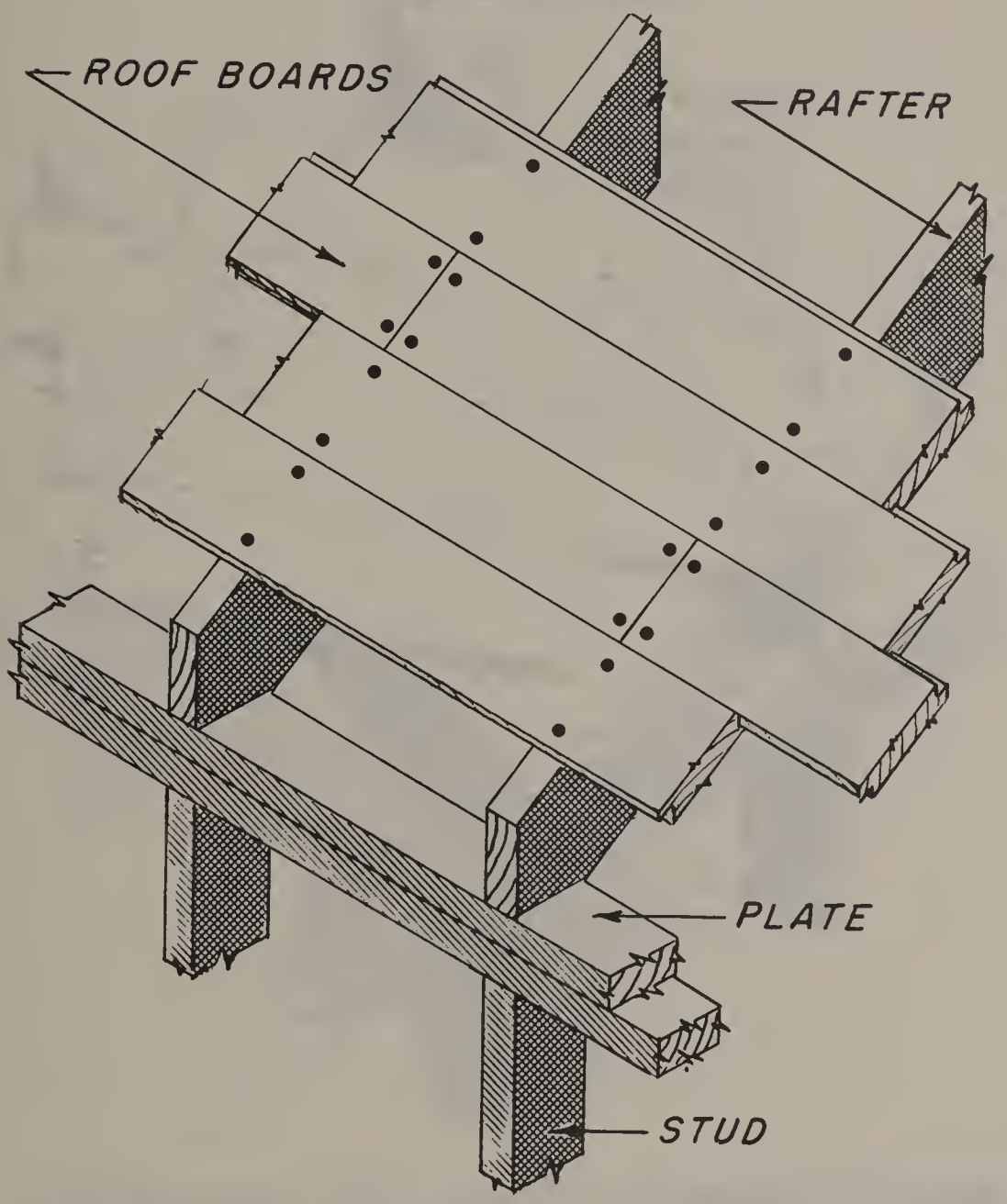


FIGURE 36.—Horizontal roof sheathing. Boards 6 inches and less in width nailed to rafters with two eightpenny nails. Wider boards nailed with three eightpenny nails. Joints in succeeding runs of sheathing boards should not occur on the same rafter.

DIAGONAL ROOF SHEATHING

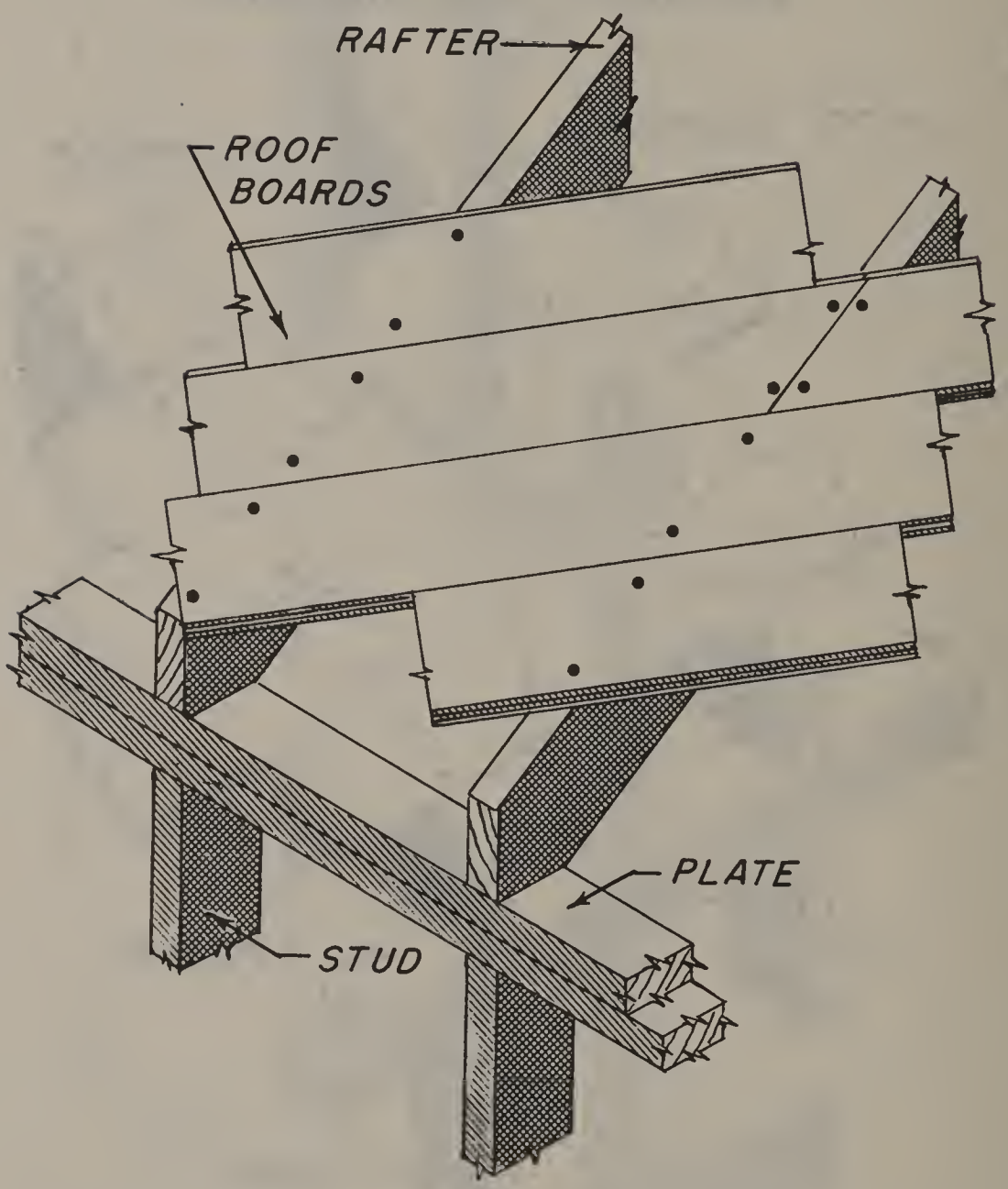


FIGURE 37.—Diagonal roof sheathing. Boards 6 inches and less in width nailed to rafters with two eightpenny nails. Wider boards nailed with three eightpenny nails. Diagonal sheathing should be similarly nailed to a 2-inch ridge and to headers cut in between and securely nailed to rafters at or near the plate. Note: Diagonal roof sheathing, although seldom used, adds rigidity to any roof. When well nailed it transfers much of the rafter thrust to the end rafters and reduces the tendency of the rafter plates to bow outward and cause sag of rafters. Plywood sheathing functions similarly.

PLYWOOD ROOF SHEATHING

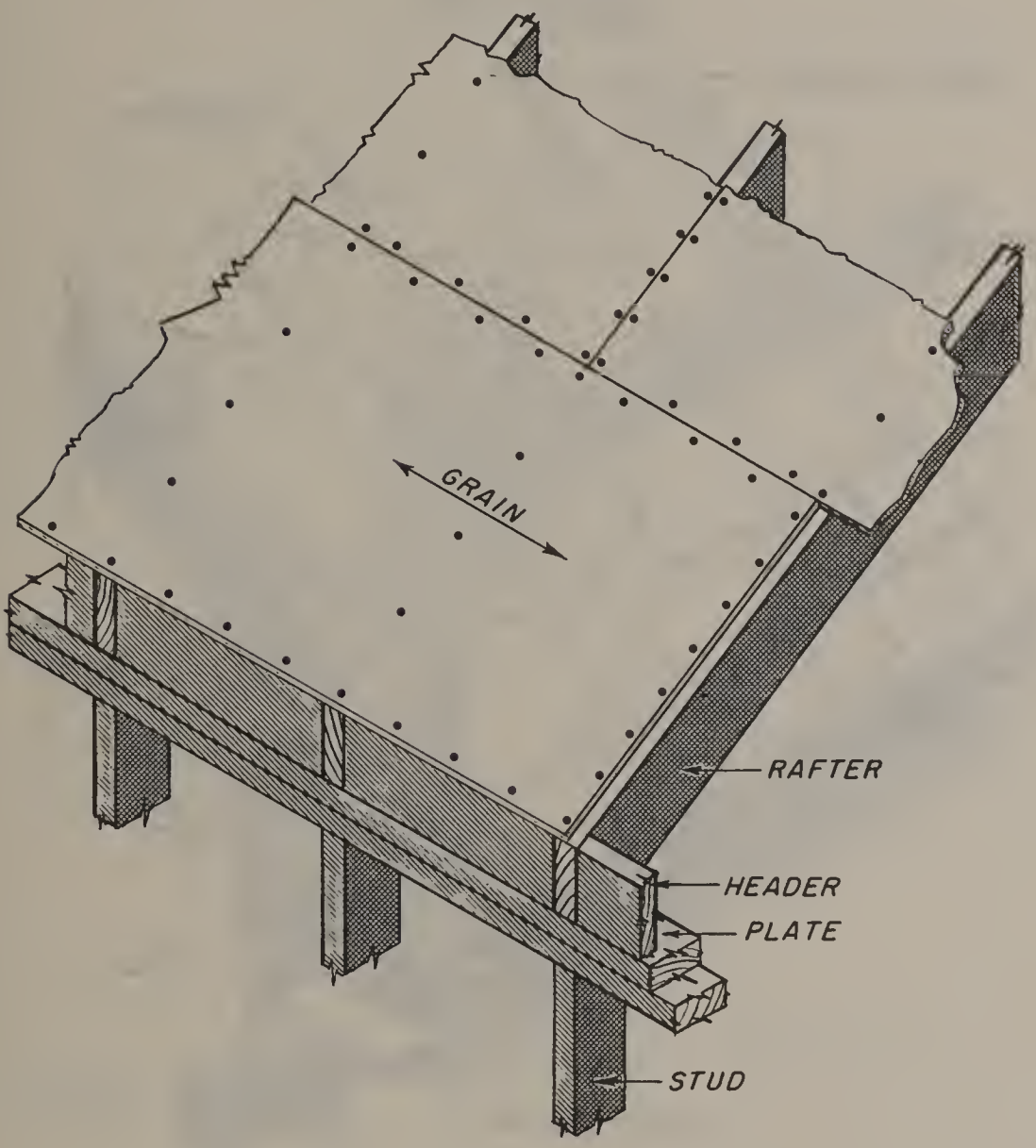


FIGURE 38.—Plywood roof sheathing. Nailed around edges with eightpenny nails spaced 5 inches and to intermediate rafters with eightpenny nails spaced 10 inches. Headers should be cut in between rafters, and securely nailed thereto, to support edges of the plywood and to receive the specified edge nailing. To receive the nails at the horizontal joints between the sheets of plywood, nailing strips are placed between the rafters and nailed to them.

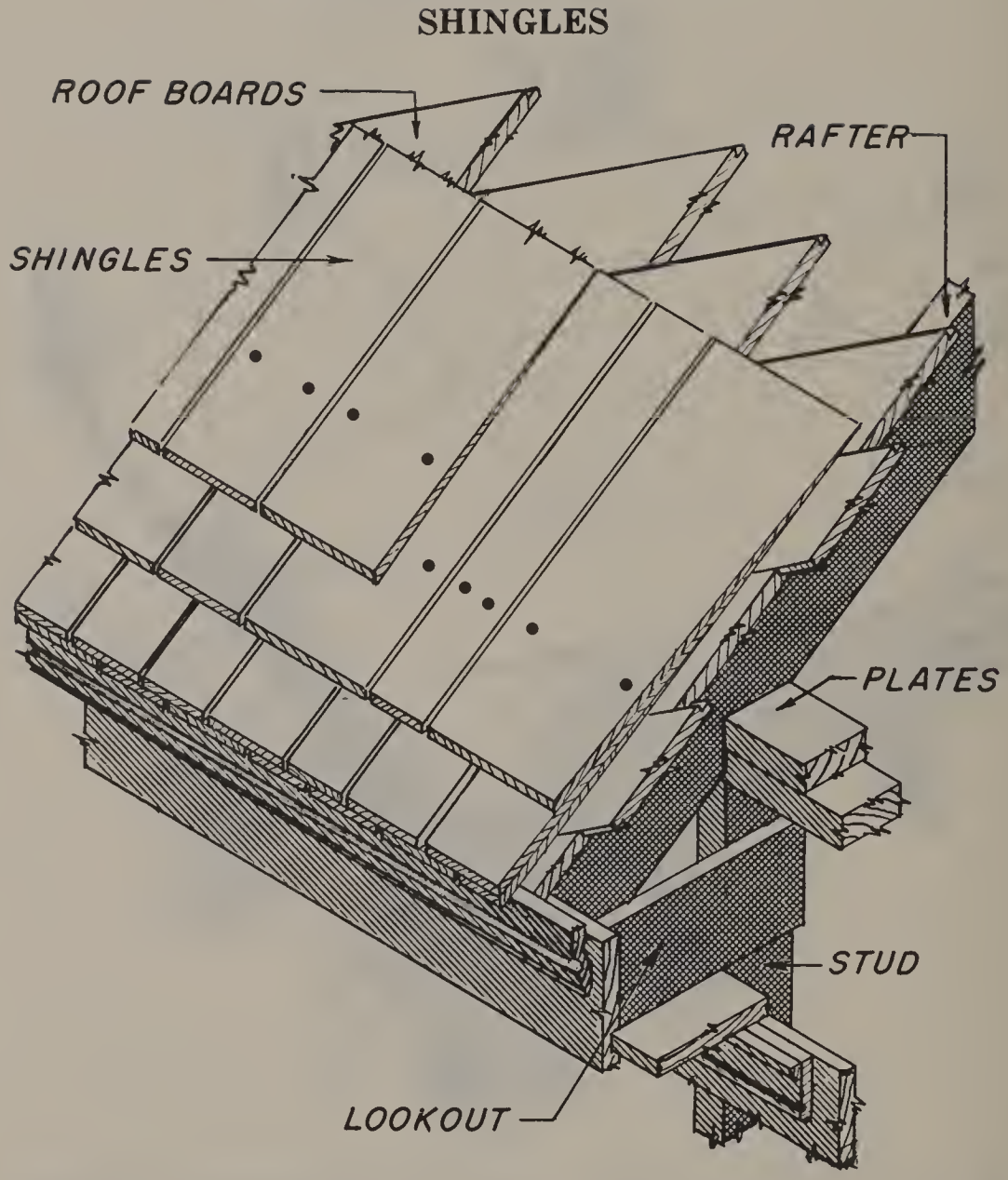


FIGURE 39.—Wood shingles. Nail 1 inch above exposure line and three-quarter inch from edge of shingle with rust-resisting nails long enough to penetrate through sheathing. Nails driven flush with face of shingles. Note: Shingles wider than about 8 inches should be split and nailed as two shingles.

BEVEL SIDING

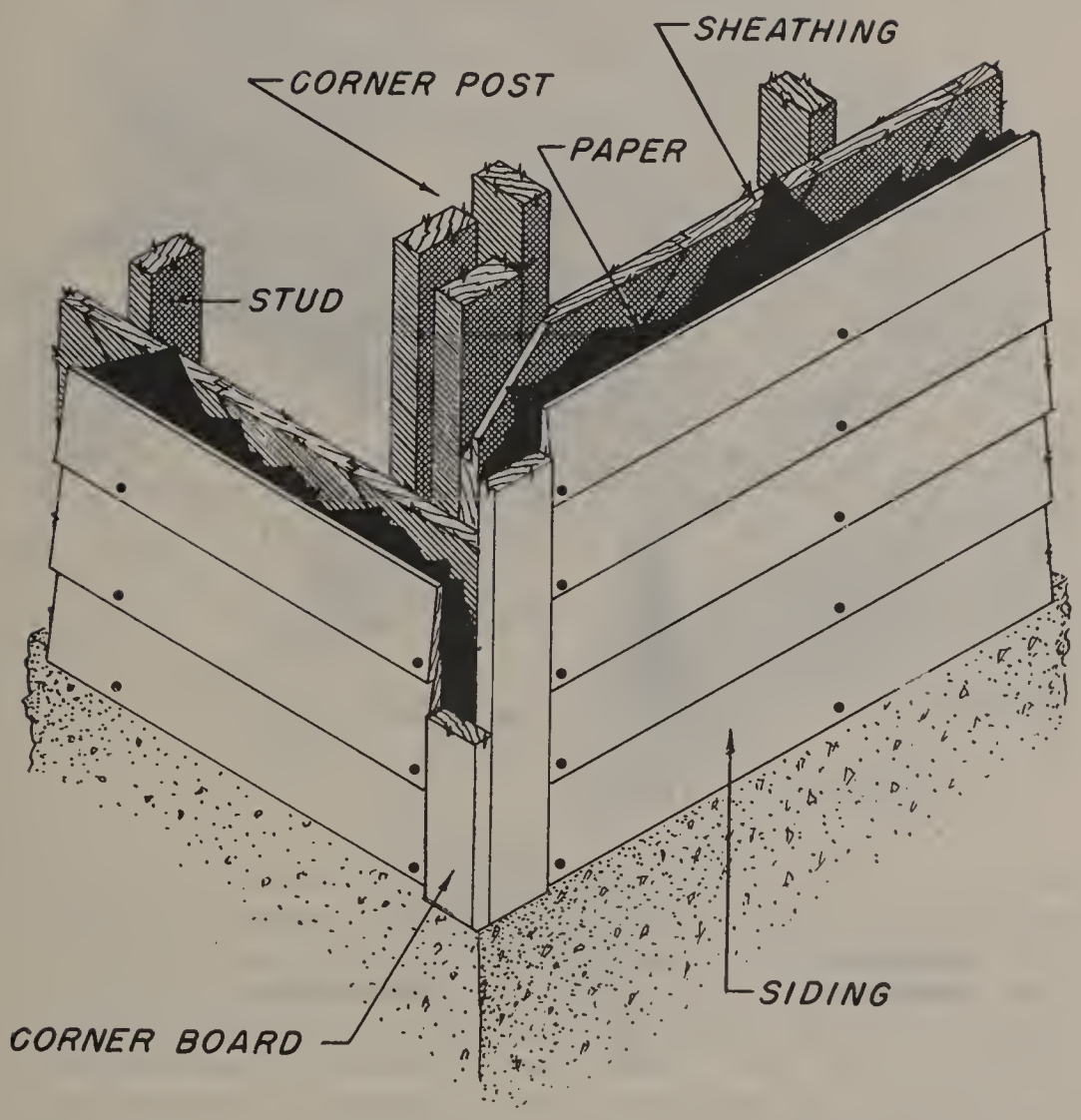


FIGURE 40.—Bevel siding. Face-nailed to each stud with two eight-penny rust-resisting casing nails driven through overlap of siding and through sheathing into each stud. Siding nails should be set and puttied. Note: If necessary, to prevent splitting holes should be bored for nails near ends of pieces of siding.

DROP SIDING

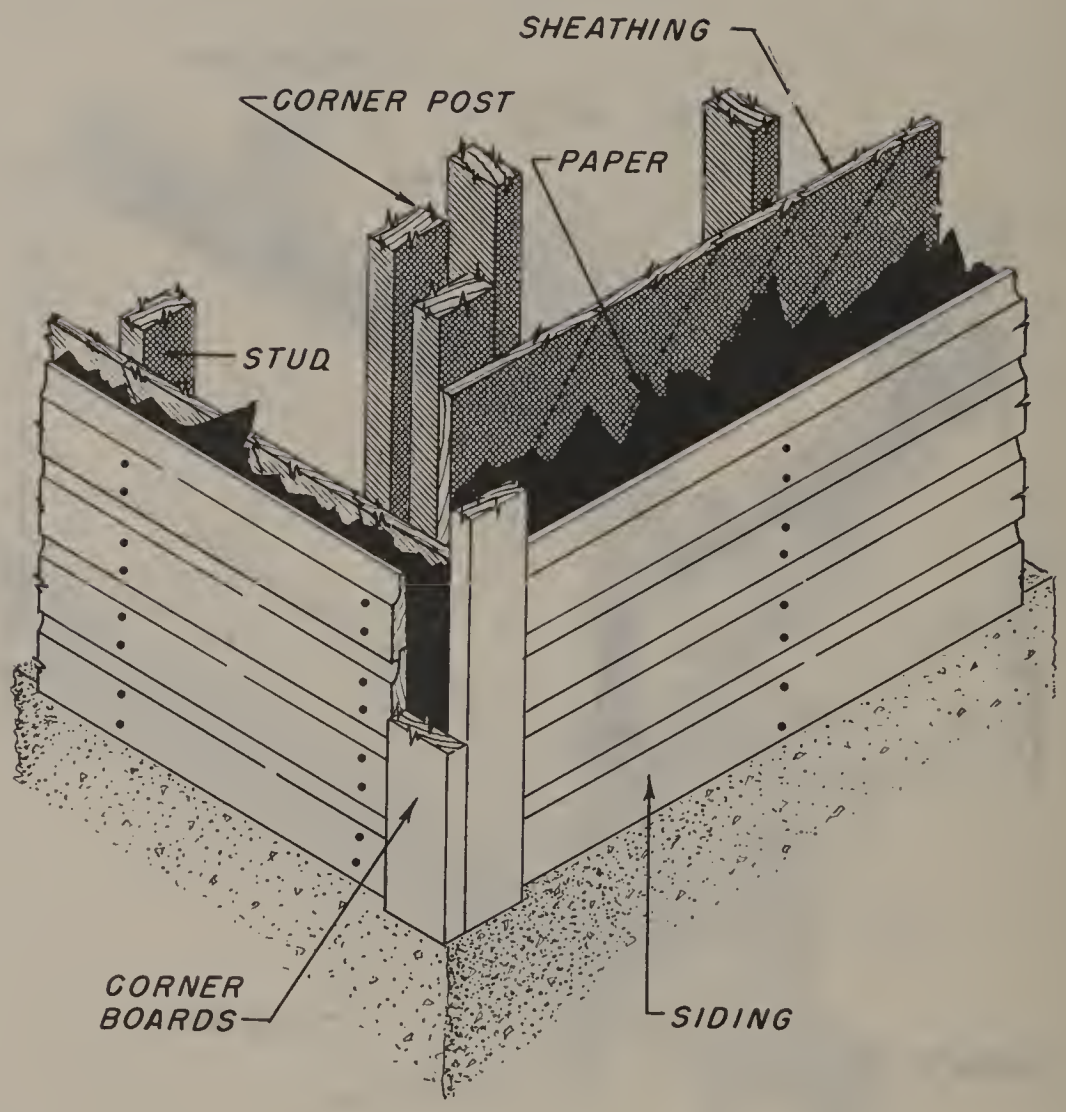


FIGURE 41.—Drop siding. Face-nailed to each stud with two ninepenny casing nails, one near lower edge and one above midheight of piece of siding. Note: As shown, ends of the drop siding are fitted against the corner boards. A common practice is to end the drop siding approximately at the corner of the frame and place the corner boards outside the siding. This leaves spaces between the corner boards and the siding into which water may be blown to cause a decay hazard.

FINISH FLOORING

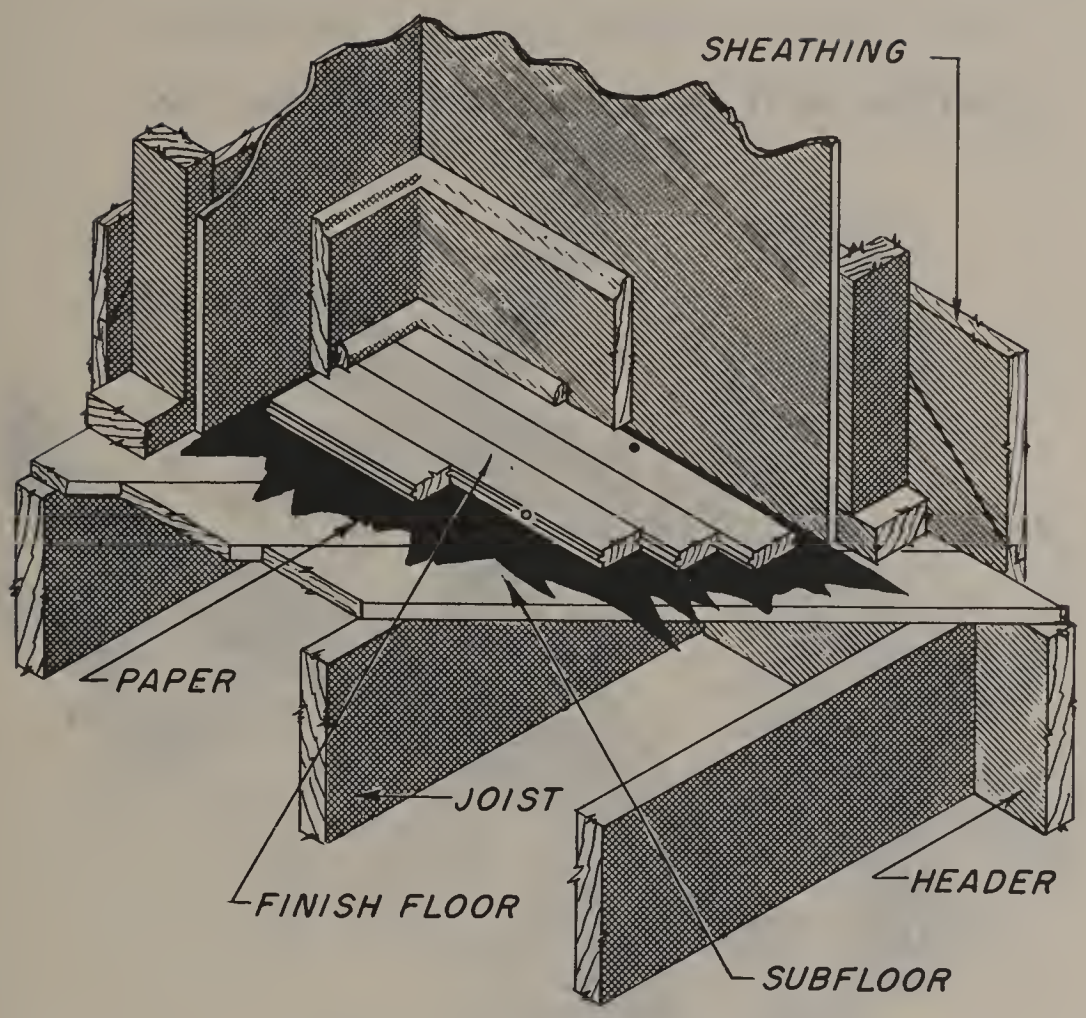


FIGURE 42.—Finish flooring. Face-nail the first strip securely to joists and subfloor with tenpenny nails so placed that the nails will be hidden by the molding. Blind-nail all strips through subflooring to joist with blunt-pointed flooring nails slanted not more than 45° from the vertical and of sufficient length to penetrate into the joist at least three-quarter inch. Note: If subflooring is laid diagonally, warping or other irregularity of its surface has less effect on the trueness of the finish floor than if subfloor is transverse to joists and, hence, parallel to the finish floor. (Laying of finish floor parallel to joists is inadvisable because when so laid, subflooring of the usual thickness does not afford a sufficiently rigid nailing base to prevent squeaking of the floor.) When subflooring of any type has become warped or loosened, it should be securely renailed before placing the finish floor.

RAFTERS AND CEILING JOIST RESTING ON WALL PLATES

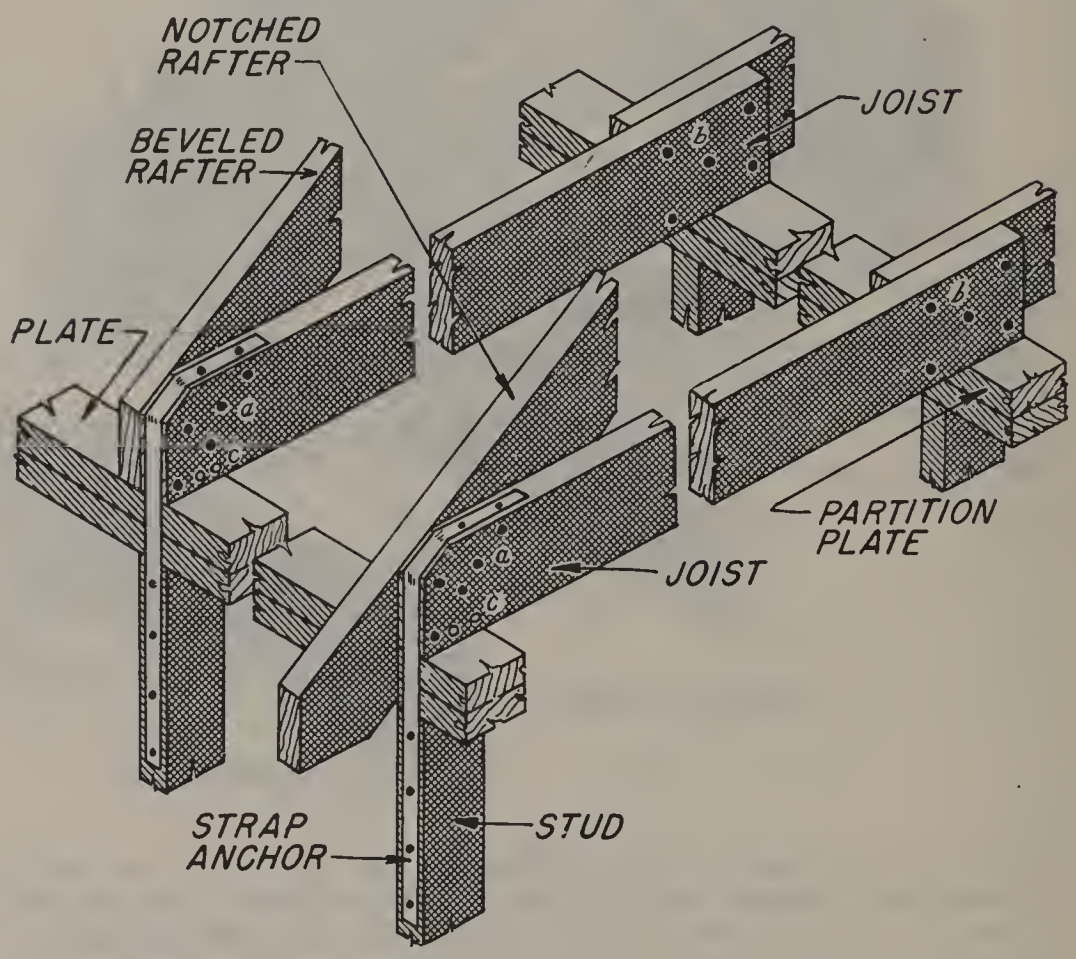


FIGURE 43.—Rafters (beveled or notched) and ceiling joist resting on wall plate. *a*, Five tenpenny nails through joist into rafter (or through rafter into joist). *b*. Overlap of joists at bearing partition nailed with five tenpenny nails. *c*, Joist and rafter toenailed to plate with four tenpenny nails, two on each side of assembly. Additional security against uplift is afforded by metal straps placed as shown and nailed with four eightpenny nails to studs and with two eightpenny nails to upper edges of joist.

NOTCHED RAFTERS RESTING ON PLATE

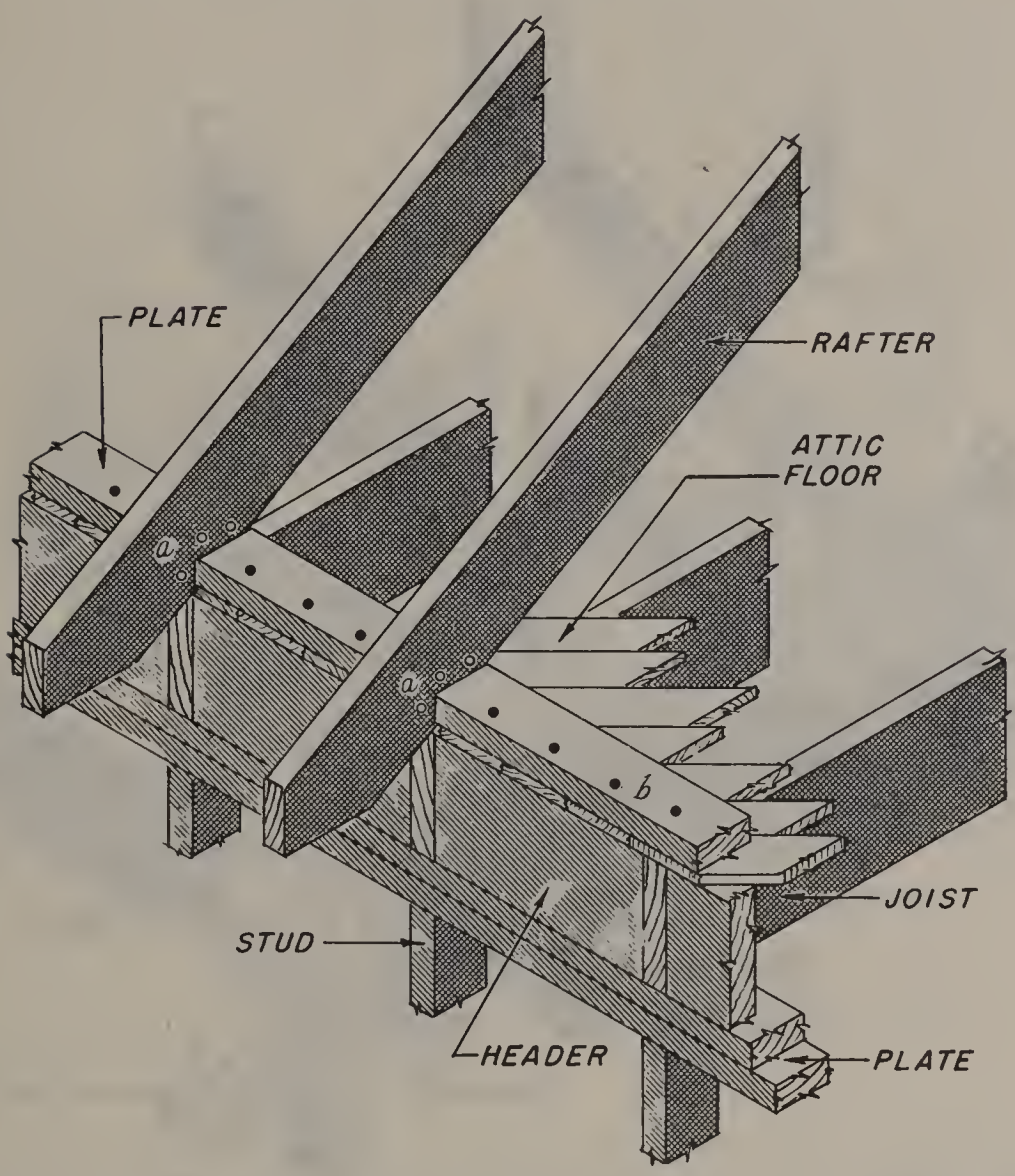


FIGURE 44.—Notched rafters resting on plate. *a*, Rafters toenailed to upper face of plate with two tenpenny nails on each side of rafter and to outer edge of plate with one tenpenny nail on each side. *b*, Plate nailed through attic floor to each joist with one sixteenpenny nail and to headers or header joist with sixteenpenny nails spaced 4 inches on centers. Additional security against uplift of rafters during high winds, if needed, may be attained through the use of metal straps as suggested in figure 49.

BEVELED RAFTERS RESTING ON PLATE

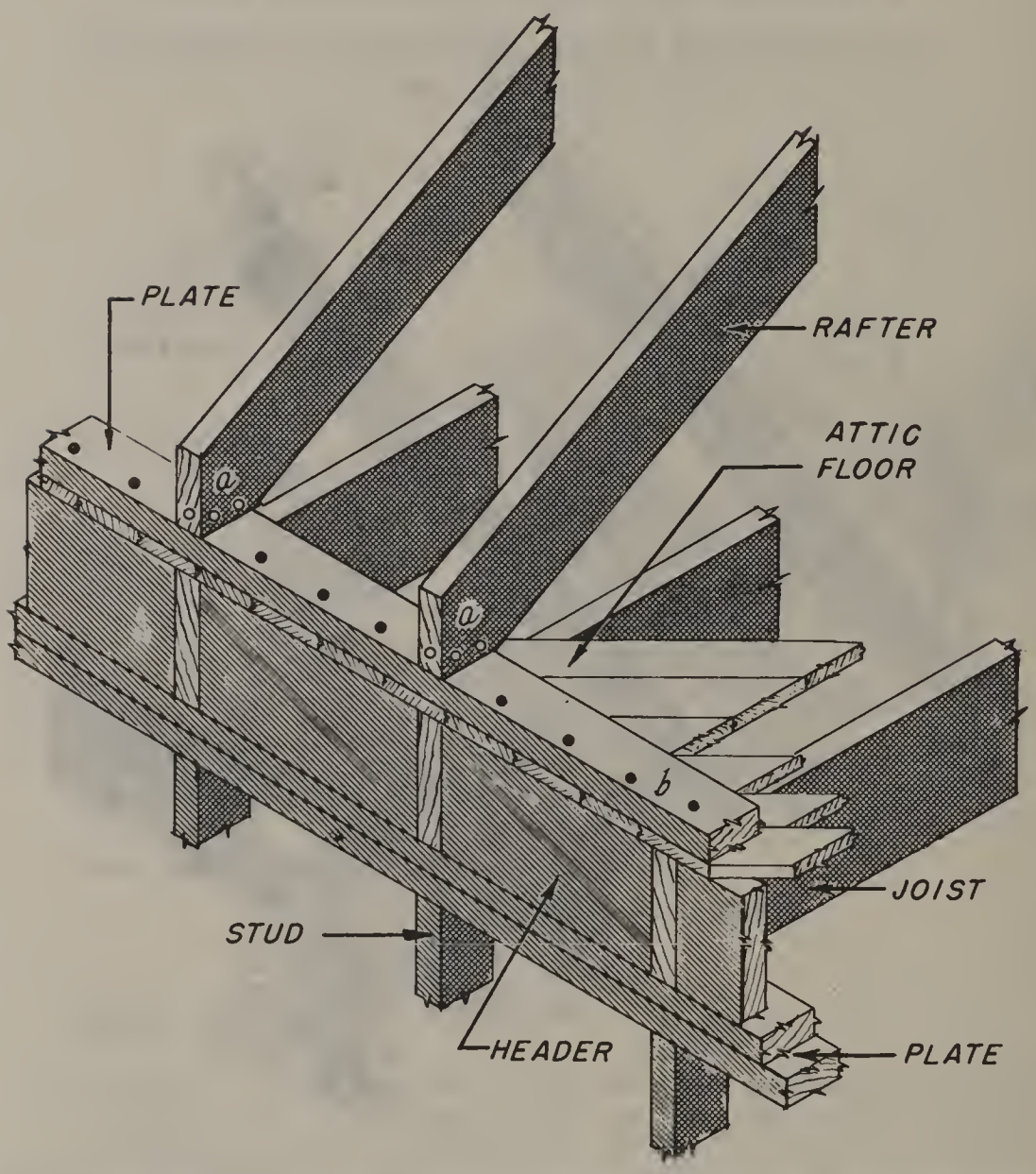


FIGURE 45.—Beveled rafters resting on plate. *a,* Rafter toenailed to plate with five tenpenny nails, two on each side and one through vertical cut of rafter. *b,* Plate nailed through attic floor to each joist with one sixteenpenny nail and to headers or header joist with sixteenpenny nails spaced 4 inches on centers. Note: Additional security against uplift, if needed, may be attained by the use of straps as shown in figure 50.

BEVELED RAFTERS BACKNOTCHED OVER PLATE

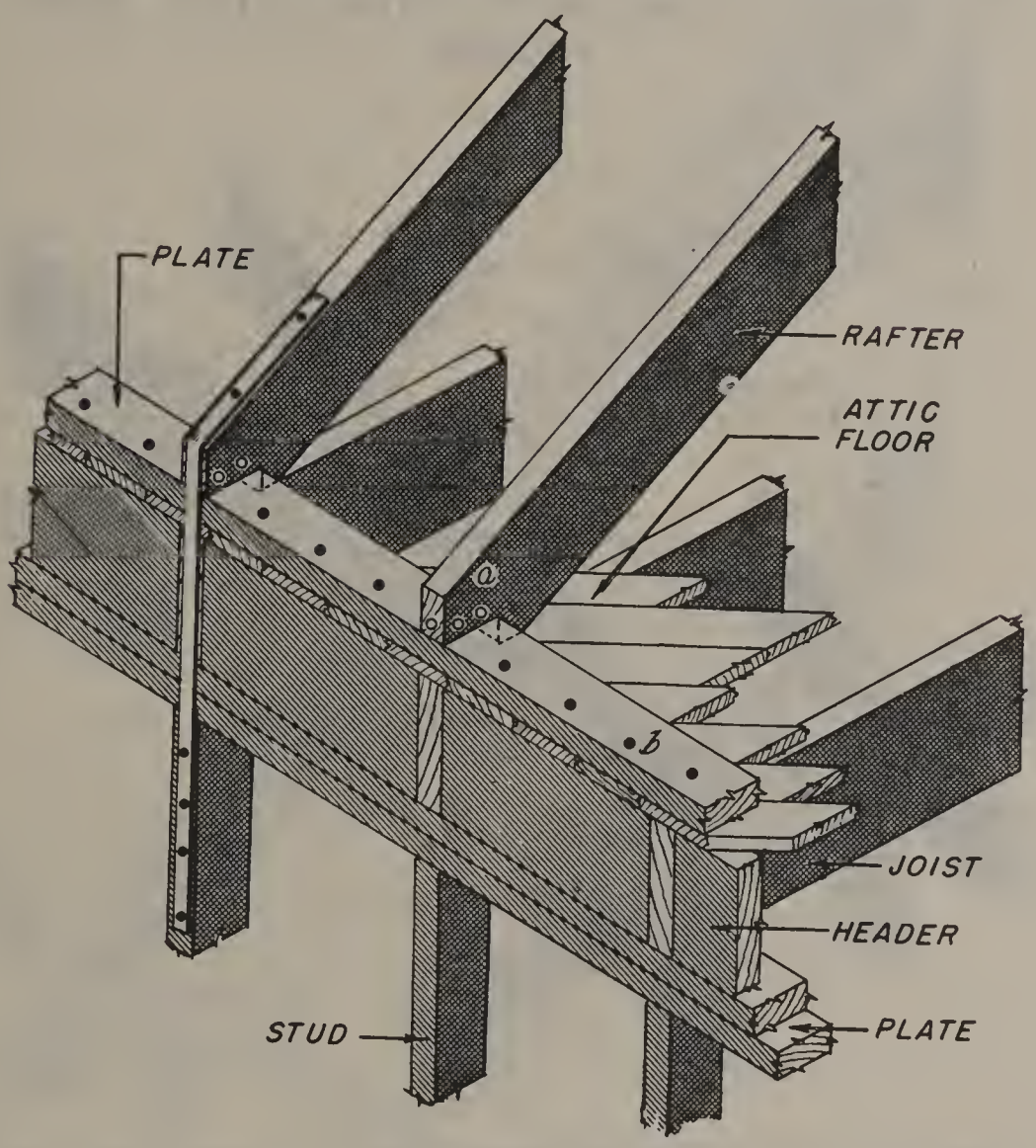


FIGURE 46.—Beveled rafters backnotched over plate. *a*, Rafter toenailed to upper face of plate with two tenpenny nails on each side and with one tenpenny nail through vertical cut of rafter. *b*, Plate nailed through attic floor into each joist with one sixteenpenny nail and into headers or header joists with sixteenpenny nails spaced 4 inches on center. Note: Thrust of rafter is resisted by the bearing against inner face of the plate. The nailing specified is not actually sufficient to resist the uplift but by adding a strap to each rafter as shown at the left it would afford a resistance to the uplift of 400 pounds.

RAFTERS AT WALL PLATE WITH CEILING JOIST HIGHER

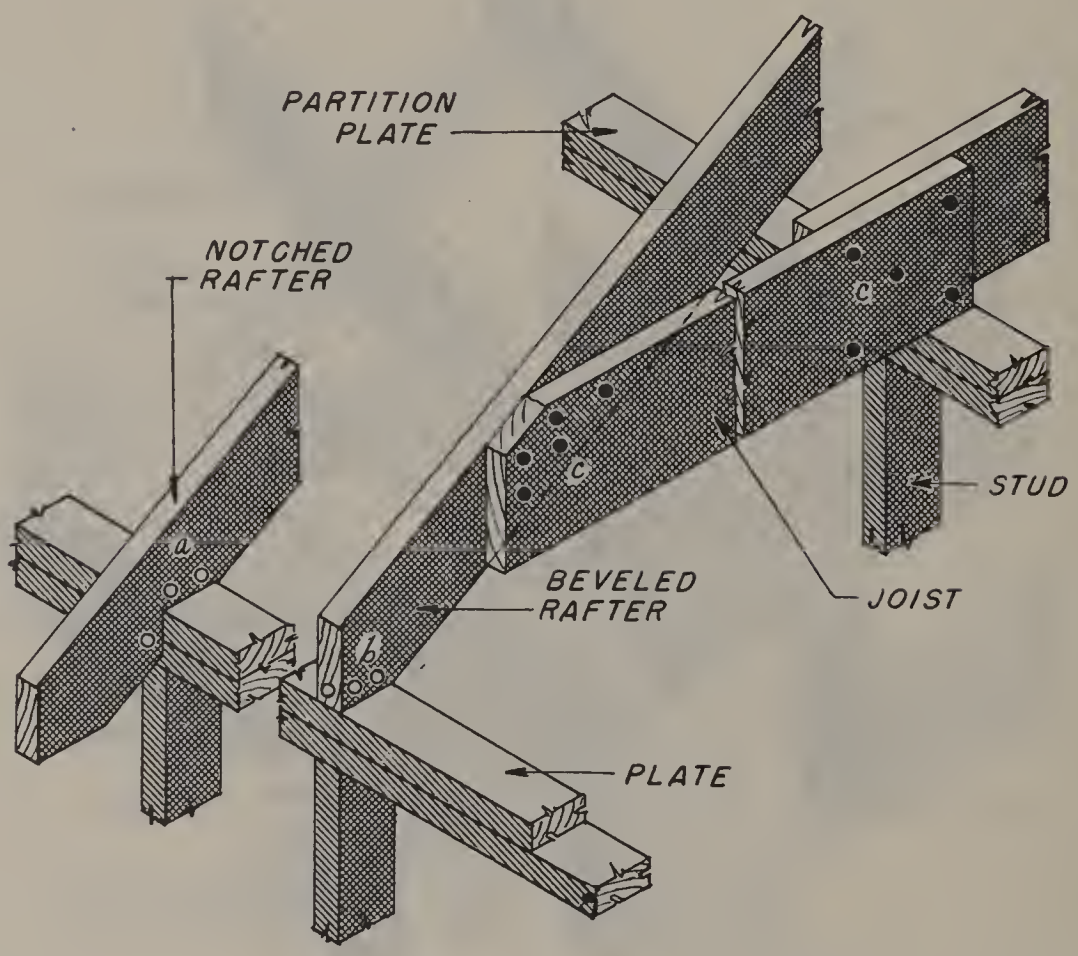


FIGURE 47.—Rafter notched or beveled at wall plate with ceiling joist at higher level. *a*, Notched rafter toenailed to upper face of plate with two tenpenny nails on each side and to outer edge of plate with one tenpenny nail on each side of rafter. *b*, Beveled rafter nailed to upper face of plate with two tenpenny nails on each side and one tenpenny nail through vertical cut of rafter. *c*, Ceiling joist nailed to rafter with five tenpenny nails and overlap nailed with five tenpenny nails. Note: This nailing affords good resistance to thrust but is deficient in resistance to uplift. Resistance to uplift can be augmented by the use of straps as shown in figures 49 and 50.

RAFTERS NOTCHED OVER PARTITION PLATE

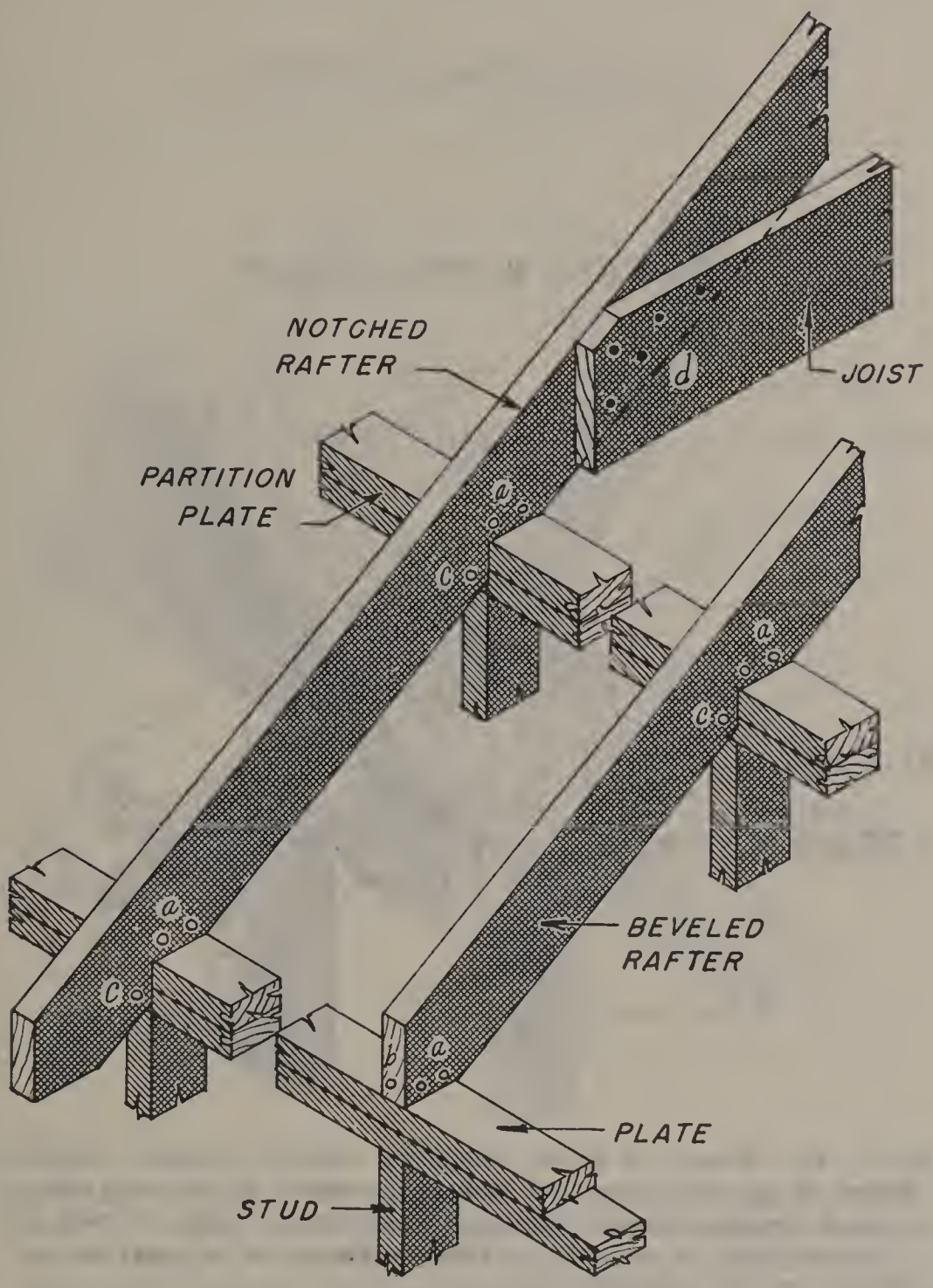


FIGURE 48.—Rafters notched or beveled at wall plate and notched over partition plate with ceiling joist above partition plate. *a*, Rafters toenailed to upper face of plate with two tenpenny nails on each side of rafter. *b*, Beveled rafter toenailed to upper face of outside wall plate with one tenpenny nail at vertical cut. *c*, Notched rafters toenailed to outer edge of plates with one tenpenny nail on each side of rafter. *d*, Ceiling joist nailed to rafter with five tenpenny nails. Note: Resistance to uplift is deficient and may be augmented by the use of straps as in figures 49 and 50.

NOTCHED RAFTER STRAPS

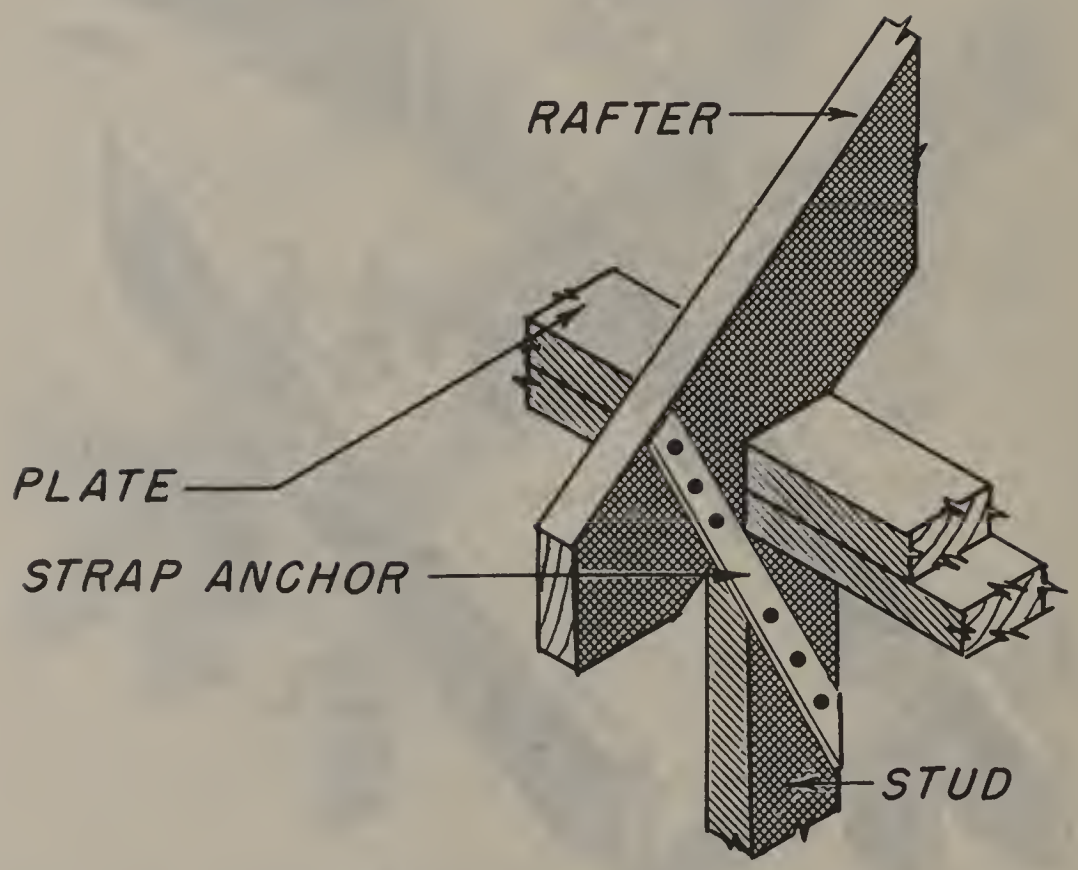


FIGURE 49.—Straps to resist uplift on notched rafters. Straps placed on opposite sides and as nearly vertical as possible, nailed to each framing member with three eightpenny nails. Straps to be in addition to nailing specified in figure 44 in order to get greater security against uplift.

BEVELED RAFTER STRAPS

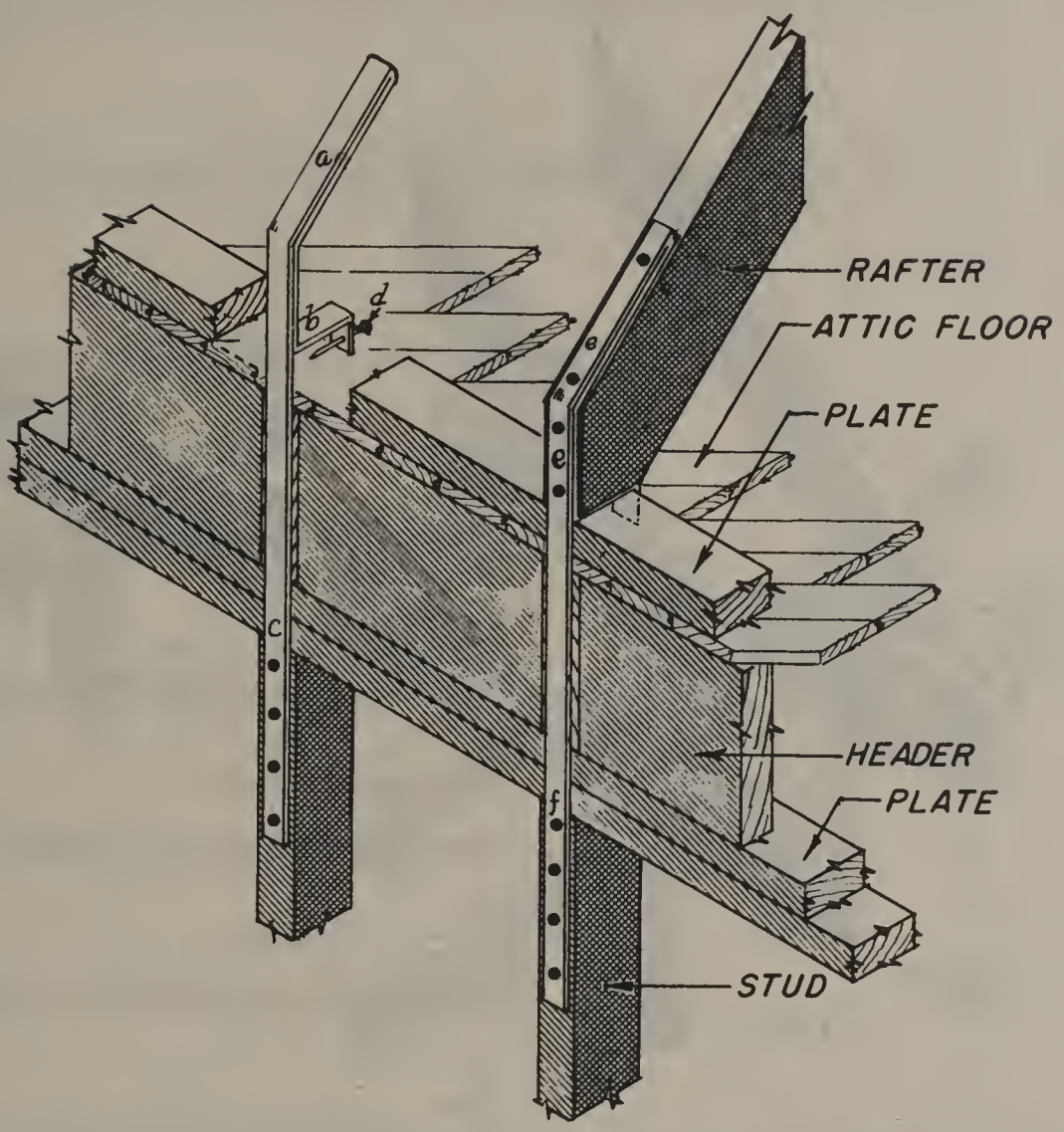


FIGURE 50.—Straps on beveled rafters to resist horizontal thrust and uplift. *a*, Strap double along upper edge and vertical cut of rafter with *b*, single thickness extending across upper and inner faces of plate and, *c*, single thickness extending down along outer edge of stud. *d*, One eightpenny nail through strap into inner edge of plate, and, *e*, two eightpenny nails through strap into upper edge and two into vertical cut of rafter, and, *f*, four into outer edge of stud.

SUPERIOR RAFTER NAILING

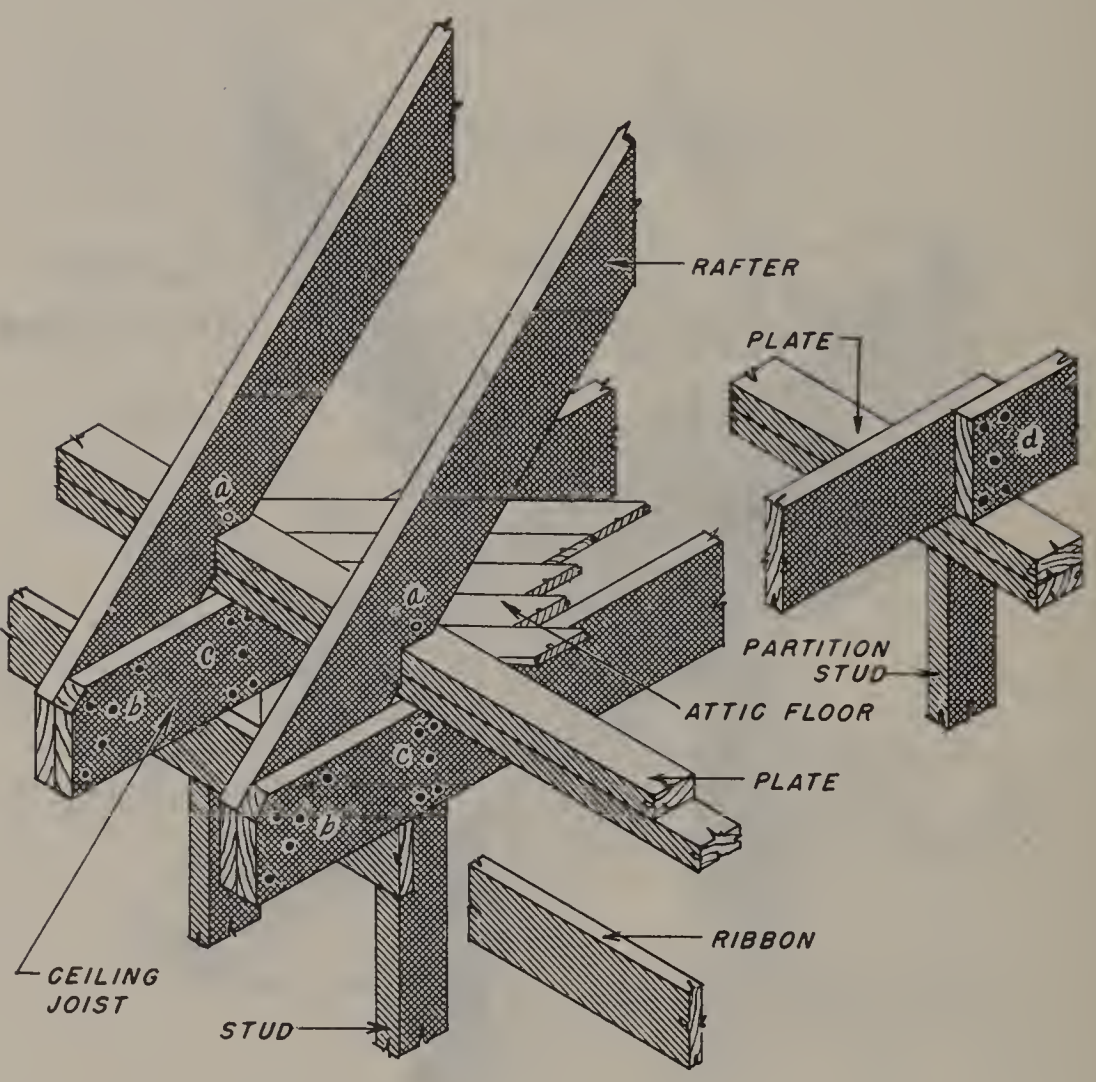


FIGURE 51.—Rafter nailing. This is a suggested framing that provides superior resistance to the forces to which rafters are subjected and, with the addition of the rafter tie or collar beam shown in figure 26, affords a very secure arrangement. The weight on the roof is carried by the plate with the rafter placed directly above the stud. *a*, Rafter toenailed to plate with one tenpenny nail. Five tenpenny nails join, *b*, rafter and joist, *c*, joist and stud, and, *d*, overlap of joists. Note: Thrust is resisted by the connection of rafter to joist, and the nailing of the joist to the stud gives resistance to uplift. Ribbon may be let into either the outer or the inner edge of stud.

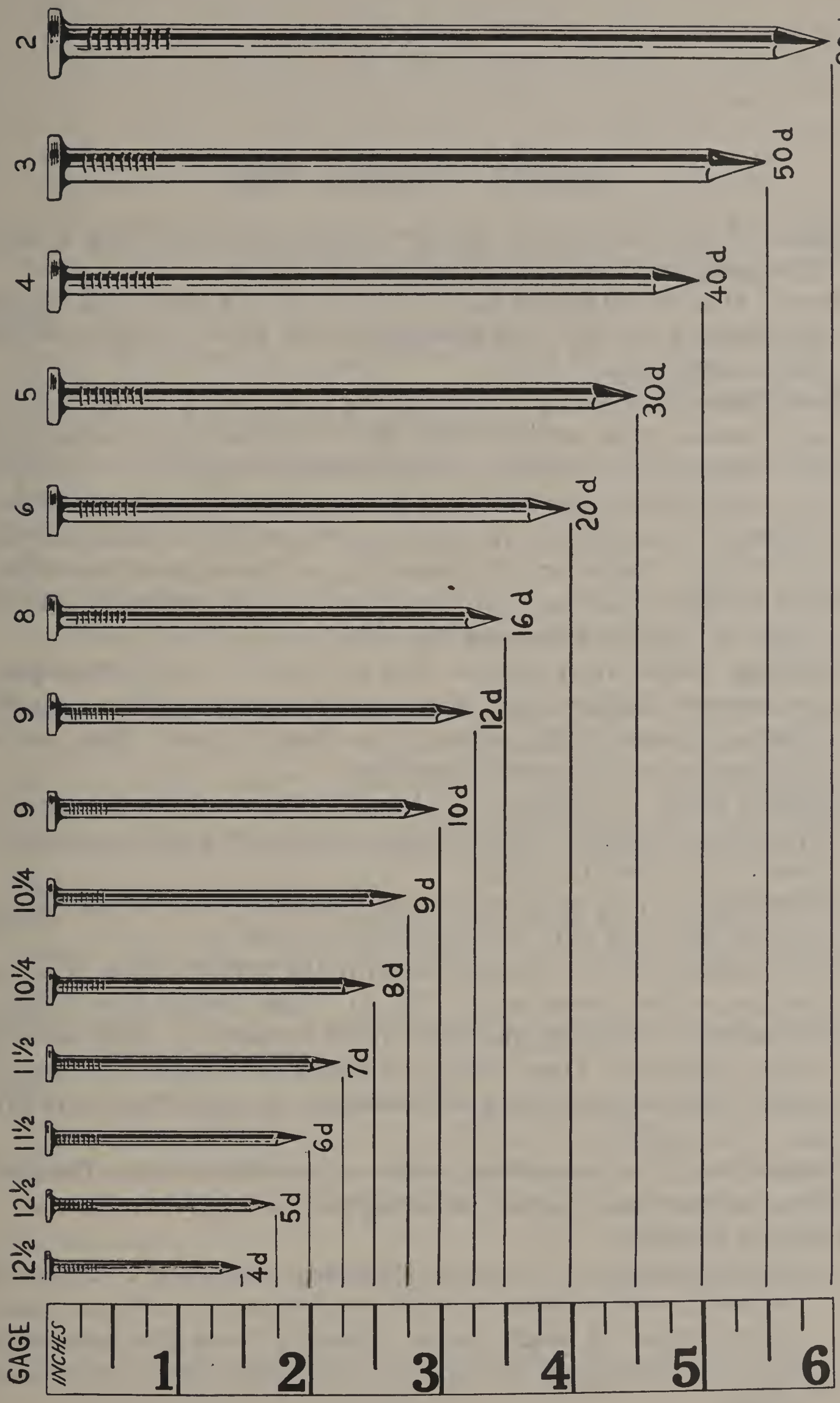


FIGURE 52.—Sizes of common wire nails.

GLOSSARY OF HOUSING TERMS

Beam. A large structural member transversely supporting a load. One example is a beam under the floor of a house.

Bevel. One side of a solid body is said to be on a bevel with respect to another when the angle between the two sides is greater or less than a right angle.

Bevel siding (lap siding). Used as the finish siding on the exterior of a house or other structure (fig. 40). It is usually manufactured by "resawing" dry, square surfaced boards diagonally to produce two wedge-shaped pieces. These pieces commonly run from three-sixteenth inch thick on the thin edge to one-half to three-fourths inch thick on the other edge, depending on the width of the siding.

Blind nailing. Nailing in such a way that the nailheads are not visible on the face of the work (fig. 42).

Bridging. Small wood members that are inserted in a diagonal position between the floor joists (fig. 12) for the purpose of bracing the joists and spreading the action of the effect of loads. They act as both tension and compression members.

Building code. A collection of legal requirements the purpose of which is to protect the safety, health, morals, and general welfare of those in and about buildings.

Collar beam. A tie beam connecting the rafters considerably above the wall plate (fig. 26). It is also called a rafter tie.

Direct nailing. To nail perpendicular to the initial surface, or to the junction of the pieces joined (fig. 1) Also termed face nailing.

Drop siding. Usually ¾ inch thick and 6 inches wide, machined into various patterns. Drop siding has tongue and groove or shiplap joints, is heavier, and has more structural strength than bevel siding. (See fig. 41.)

Foundation. The supporting portion of a structure below the first-floor construction, or grade, including the footings.

Framing systems:

Balloon framing. A system of framing a building in which all vertical structural elements of the exterior walls, particularly the studs, consist of single pieces extending from the foundation sill to the roof plate, and support intermediate floor and ceiling joists.

Braced framing. A system of framing a building in which all vertical structural elements of the bearing walls and partitions,

except corner posts, extend for one story only, starting at the foundation sill for the first-story framing and at the top plate of the story below for all stories above the first. Corner posts extend from foundation sill to roof plate and are braced by diagonal members usually extending the full height of each story and crossing several of the studs in each outer wall.

Platform framing. A system of framing a building on which floor joists of each story rest on the top plates of the story below (or on the foundation sill for the first story) and the bearing walls and partitions rest on the subfloor of each story.

Gable. That portion of a wall contained between the slopes of a double-sloped roof, on a single-sloped roof, that portion contained between the slope of and a line projected horizontally through the lowest elevation of the roof construction.

Girder. A large or principal beam used to support concentrated loads at particular points along its length.

Grain. The direction, size, arrangement, appearance, or quality of the fibers in wood.

Grout. Mortar made so thin by the addition of water that it will all run into the joints and cavities of the masonwork and fill them up solid (fig. 7).

Header. A beam placed perpendicular to joists and to which joists are nailed in framing for a chimney, stairway, or other opening. More generally, a piece or member that makes a T-joint with other members (fig. 7) ; often a short piece extending between other members and at right angles to them (fig. 38) ; frequently used instead of lintel as in figures 23 and 24.

Joist. One of a series of parallel beams used to support floor and ceiling loads (fig. 13), and supported in turn by larger beams, girders, or bearings walls.

Ledger strip. A strip of lumber nailed along the bottom of the side of a girder on which joists rest.

Lintel. A horizontal structural member which supports the load over an opening such as a door or window (figs. 23 and 24).

Lookout. A short wood bracket or cantilever to support an overhanging portion of a roof or the like, usually concealed from view fig. 39).

Partition. A wall that subdivides space within any story of a building.

Partition types:

Bearing partition. A partition which supports any vertical load in addititon to its own weight.

Nonbearing partition. A partition extending from floor to ceiling but which supports no load other than its own weight.

Penny. As applied to nails it originally indicated the price per hundred. The term now serves as a measure of nail length and is abbreviated by the letter "d" (fig. 52.).

Plate:

1. A horizontal structural member placed on a wall or supported on posts, studs, or corbels to carry the trusses of a roof or to carry the rafters directly.
2. A shoe or base member, as of a partition or other frame.
3. A small, relatively thin member placed on or in a wall to support girders, rafters, etc.

Plywood. A piece of wood made of three or more layers of veneer joined with glue and usually laid with the grain of adjoining plies at right angles. Almost always an odd number of plies are used to secure balanced construction.

Porch. A floor extending beyond the exterior walls of a building. It may be enclosed or unenclosed, roofed or uncovered.

Rabbet. A rectangular longitudinal groove cut in the corner of a board or other piece of material (figs. 32, 33, 36).

Rafter. One of a series of structural members of a roof designed to support roof loads. The rafters of a flat roof are sometimes called roof joists.

Rafter types:

Hip rafter. A rafter which forms the intersection of an external roof angle (fig. 25).

Jack rafter. A rafter which spans the distance from a wall plate to a hip or from a valley to a ridge (fig. 25).

Valley rafter. A rafter which forms the intersection of an internal roof angle.

Ribbon. A narrow board let into the studding to add support to joists.

Ridge. The horizontal line at the junction of the top edges of two sloping roof surfaces (fig. 26). The rafters of both slopes are nailed to the ridge board.

Roof. The entire construction used to close in the top of a building.

Sheathing. The structural covering, usually of boards, plywood, or wallboards, placed over exterior studding or rafters of a structure.

Sheathing paper. A building material used in wall, floor, and roof construction to resist the passage of air (figs. 41 and 42).

Shingles. Roof covering of wood cut to stock lengths and thicknesses, and to random widths (fig. 39).

Sill:

1. The lowest member of the frame of a structure, usually horizontal, resting on the foundation and supporting the uprights of the frame.

2. That member forming the lower side of an opening, as door sill, window sill, etc. (figs. 23 and 24).

Sole or sole plate. A horizontal member, usally a 2 by 4, on which wall and partition studs rest.

Span. The distance between structural supports such as walls, columns, piers, beams, girders, and trusses.

Stud. One of a series of slender wood structural members used as supporting elements in walls and partitions (Plural: studs or studding).

Subfloor. Boards or matched lumber laid on joists over which a finish floor is to be laid.

Tail beam. A relatively short beam or joist supported in a wall on one end and by a header on the other (fig. 22).

Toenailing. To drive a nail at a slant with the initial surface in order to permit it to penetrate into a second member (fig. 1).

Trim. The finish materials in a building, such as moldings applied around openings (window trim, door trim) or at the floor and ceiling of rooms (baseboard, cornice, picture molding).

Trimmer. A beam or joist to which a header is nailed in framing for a chimney, stairway, or other opening (fig. 22).

Wall, bearing. A wall which supports any vertical load in addition to its own weight.

Wallboard. Wood pulp, gypsum, or similar materials made into large, rigid sheets that may be fastened to the frame of a building to provide a surface finish.

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